AUTONOMOUS CARS AND TORT LIABILITY

*By Kyle Colonna**

I. INTRODUCTION

Imagine jumping into your car after a long day of work, entering your address into the car's computer, and falling asleep while the car navigated its way to your home. According to Nady Boules, General Motor's Director of the Electrical and Control Integration Lab, this technology is only ten years away from becoming a reality.[1] Unfortunately, there are currently legal barriers that would prevent car manufacturers from introducing this technology. For example, forty-nine states have driver's license and examination laws, which make it illegal for a car to drive itself without a licensed operator.[2]

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1. Larry Webster, *The Age of the Car That Drives Itself*, POPULAR MECHANICS (Oct. 18, 2010, 12:00 PM), http://www.popularmechanics.com/cars/news/industry/the_age-of-the-car-that-drives-itself (discussing Google's "fleet of driverless Toyota Priuses" that have driven autonomously for 140,000 miles).

2. Matthew Moore & Beverly Lu, *Autonomous Vehicles for Personal Transport: A Technology Assessment*, CAL. INST. OF TECH. 6 (June 2, 2011), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1865047 ("[W]e interviewed Ryan Calo, the director of the Consumer Privacy Project at Stanford Law School's Center for Internet and Society. Calo made it clear that the legal issues behind autonomous driving are not fully sorted yet, but explained that the legal code relating to this technology essentially boils down to the following: 'every vehicle needs to have a licensed operator.'"); *see also Year of First State Driver License Law and First Driver Examination*, U.S. DEP'T OF TRANSP. (Apr. 1997), *available at* http://www.fhwa.dot.gov/ohim/summary95/dl230.pdf (showing a list of all states with driver's license and examination laws). In Illinois, the Secretary of State has set the minimum age to obtain a valid driver's license at sixteen. *See Illinois Graduated Driver Licensing System*, ILL. SEC'Y OF STATE, http://www.cyberdriveillinois.com/departments/drivers/teen_driver_safety/gdl.html (last visited Oct. 4, 2012). The issue is that a machine neither qualifies to obtain a driver's license nor can it pass the driver's examination under the current law. Most, if not all states, have similar laws; therefore, in forty-nine of the fifty states, autonomous cars are not legal on a mere technicality.

On June 16, 2011, Nevada passed bill A.B. 511[3] and became the first state to amend its current transportation statute to expressly recognize autonomous cars as a legal form of transportation.[4] Although Nevada took the first step in legalizing autonomous cars, the statute failed to provide any specific regulations tailored to cars with autonomous technology.[5] Instead, A.B. 511 charges the Nevada Department of Transportation with the task of subsequently creating autonomous car regulations.[6]

Approximately four months later, the Nevada Department of Motor Vehicles proposed "minimum safety standards" for autonomous vehicles, which define autonomous technologies, set testing and certification requirements, establish minimum safety standards, and

3. Stan Hanel, *Driverless cars tested in Nevada*, LAS VEGAS REV.-J. (Oct. 14, 2011, 11:22 AM), http://www.lvrj.com/drive/driverless-cars-tested-in-nevada-131846728.html (last updated Oct. 14, 2011, 11:22 AM) ("AB 511 passed through the Assembly Ways and Means Committee as well as the Senate Finance Committee, where it was amended twice before being voted for final passage by both state houses. Gov. Sandoval signed the bill into law on June 16, and Nevada became the first state in the nation to allow driverless vehicles onto designated roadways.").

4. Clay Dillow, *Nevada Is the First State to Pass Driverless Car Legislation, Paving the Way for Autonomous Autos*, POPSCI (Jun. 23, 2011, 4:15 PM), http://www.popsci.com/cars/article/2011-06/nevada-passes-driverless-car-legislation-paving-way-autonomous-autos (discussing Nevada passing Assembly Bill No. 511, which gives the Nevada Department of Transportation authorization to "draft a set of regulations and rules governing autonomous cars"); *see also* A.B. 511, 2011 Legis., Comm. on Transp., 76th Sess. (Nev. 2011), *available at* http://cyberlaw.stanford.edu/system/files/AB511_EN.pdf; *see also* Bryant Walker Smith, *Backseat Driving*, THE CTR. FOR INTERNET AND SOC'Y (Jan. 31, 2012, 9:12 PM), http://cyberlaw.stanford.edu/blog/2012/02/backseat-driving (discussing how the state legislatures for Nevada, Florida, Hawaii, Arizona and Oklahoma are taking measures to "expressly regulate automated driving").

5. *See* Evan Ackerman, *Nevada Bill Would Provide Tentative Roadmap for Autonomous Vehicles*, IEEESPECTRUM (Apr. 29, 2011), http://spectrum.ieee.org/automaton/robotics/artificial-intelligence/nevada-bill-would-provide-tentative-roadmap-for-autonomous-vehicles (discussing how Nevada's "new bill," A.B. 511, is "very vague."); *see also* A.B. 511, 2011 Legis., Comm. on Transp., 76th Sess. (Nev. 2011), *available at* http://cyberlaw.stanford.edu/system/files/AB511_EN.pdf.

6. A.B. 511, 76 Legis., Comm. on Transp., 76th Sess. (Nev. 2011), *available at* http://cyberlaw.stanford.edu/system/files/AB511_EN.pdf ("The Department shall adopt regulations authorizing the operation of autonomous vehicles on highways within the State of Nevada.").

set forth driver's license and registration requirements.[7] On February 15, 2012, Nevada's Legislative Commission adopted the first autonomous car regulations in the United States.[8]

While most of the provisions are not out of the ordinary, Sections 3 and 4.2 define the "operator" of the vehicle as the person who "causes the autonomous vehicle to engage . . . ."[9] The regulations, moreover, deem the operator as the driver of the vehicle for "purpose[s] of enforcing traffic laws and other laws applicable to drivers and motor vehicles operated in [Nevada]."[10] Hence, if the owner of an autonomous car "engages"[11] his autonomous vehicle and it "runs" a red light while in autopilot mode, the owner would technically incur liability for the infraction.

Nevada's new law accounts for violations arising out of an operator's action or inaction.[12] However, the law is less clear about violations caused by manufacturer errors.[13] Products liability and strict tort theories impute liability on the manufacturers of defective hardware or software, and the Nevada Department of Motor Vehicles

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7. Proposed Reg. of the Dep't of Motor Vehicles, LCB File No. R084-11 (proposed Oct. 16, 2011) (to be codified at 483 NAC, 482 NAC, 487 NAC, 484 NAC), *available at* http://leg.state.nv.us/register/2011Register/R084-11I.pdf. (proposing regulations for autonomous cars, specifically: definitions for autonomous car technology, testing requirements, certification requirements, minimal safety requirements, driver's license endorsement, and registration requirements).

8. Nev. Dep't of Motor Vehicles, *Regulations Clear the Road for Self-driving Cars*, DMVNV.COM (Feb. 15, 2012), http://www.dmvnv.com/news/12001-regulations-for-self-driving-cars.htm ("In a step that puts Nevada first in the nation while paving the way for unique economic opportunity, the Legislative Commission today approved regulations allowing for the operation of self-driving vehicles on the state's roadways.").

9. Reg. Relating to Autonomous Vehicles, 482A NAC §4.2, 2 (2012), *available at* http://www.leg.state.nv.us/register/2011Register/R084-11A.pdf ("For the purpose of enforcing the traffic laws and other laws applicable to drivers and motor vehicles operated in this State, the operator of an autonomous vehicle that is operated in autonomous mode shall be deemed the driver of the autonomous vehicle regardless of whether the person is physically present in the autonomous vehicle while it is engaged.").

10. *Id.*

11. *See* Smith, *supra* note 4 ("This language raises at least three questions. What 'causes' the engagement? Is the person causing it necessarily a natural person? And can the DMV lawfully deem that person to be the driver of a vehicle that by statute 'drive[s] itself?'").

12. *See* Reg. Relating to Autonomous Vehicles, *supra* note 9, § 4.2.

13. *Id.*

has adopted a similar stance toward autonomous car manufacturers.[14] Nevertheless, imputing substantial liability upon the manufacturers of autonomous technology and cars is improvident because it would hinder autonomous cars from entering into the marketplace in a timely fashion.[15] Thus, although autonomous car technology is advancing rapidly and striving towards mass availability, the liability issues will dictate how quickly autonomous cars enter into the marketplace.[16]

Attributing substantial liability to manufacturers of autonomous cars and the manufacturers of autonomous car technology is worrisome because of the substantial social utility of autonomous cars.[17] Presumably, autonomous cars will save millions of lives and

14. INFO. STATEMENT OF ADOPTED REG. AS REQUIRED BY ADMIN. PROCEDURES ACT NRS 233B.066, LCB FILE NO. R084-11, at 31 (Feb. 6, 2012), *available* *at* http://www.leg.state.nv.us/register/2011Register/R084-11A.pdf ("This is a product liability situation that is handled today through our justice system.").

15. *See* John Markoff, *Collision in the Making Between Self-Driving Cars and How the World Works*, N.Y. TIMES, Mar. 17, 2012, at B6 (discussing how the "potential liabilities will be huge for the designers and manufacturers of autonomous vehicles," and that without some legal protections, no company will put money into developing them). If the manufacturers of autonomous cars will not make a profit, they will not produce the cars. *See* Phil LeBeau, *The Auto Industry's Six Profit Drivers*, CNBC.COM (Mar. 21, 2012, 9:07 AM), http://www.cnbc.com/id/46806437/ ("Strip away the marketing and auto shows there is one ultimate goal for the automakers: make the most money possible on each automobile.").

16. *See* Doug Gross, *Look, no hands! The driverless future of driving is here*, CNN.COM (Feb. 22, 2012), http://whatsnext.blogs.cnn.com/2012/02/22/the-sci-fi-future-of-driving-its-already-here/ (referring to a quote by Scott Belcher, CEO of the Intelligent Transportation Society of America, who stated that "[i]t's going to be the liability issues, the control issues that are going to prevent [the success of autonomous cars]").

17. *See* discussion *infra* Section III.D; *see also* James Poulos, *Driverless Cars for All: An Idea More Dangerous Than Driving*, FORBES.COM (Mar. 13, 2012, 3:23 PM), http://www.forbes.com/sites/jamespoulos/2012/03/13/driverless-cars-for-all-an-idea-more-dangerous-than-driving/ ("Advances in information processing mean driverless cars are coming, and fast. If you live in the Bay Area, actually, they're already here. Let's say—and I don't know if this is optimistic or pessimistic—that full adoption of driverless cars could cut the number of [car] accidents in half. . . . In 2010, more than 32,000 Americans were killed in car accidents, more than 2 million were injured, and the resulting medical costs and productivity losses were, according to the Centers for Disease Control and Prevention, in the $100 billion range. Car accidents are the leading cause of death for Americans between the ages of one and 30. If we could halve all that, it would be, in the first case, an enormous win for human welfare and in

billions of dollars once they are introduced into the marketplace.[18] The issue is that "[t]he technology is ahead of the law in many areas," according to Bernard Lu, senior staff counsel for the California Department of Motor Vehicles.[19] Consequently, while Nevada's regulations are a springboard for regulating autonomous cars,[20] the proposed regulations are insufficient because they do not directly address the complex liability and economic issues that will inevitably arise when the autonomous technology—as opposed to a human action—causes damage or injury.[21]

In the 1950s, the private nuclear power industry faced a similar liability conundrum.[22] Although the government yearned for private investment in nuclear energy, the private sector was uncertain about its liability.[23] As a result, Congress passed the Price-Anderson Act.[24] This created a successful, two-tiered insurance program, which effectively overcame the economic and legal uncertainties of private

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the second case, a huge change in the composition of medical expenditures, with far less trauma care. . . .") (quoting Ezra Klein, *Does Your Model for Future Health-Care Spending Account for Driverless Cars?*, WASH. POST (Mar. 10, 2012 11:23 AM), http://www.washingtonpost.com/blogs/ezra-klein/post/why-we-cant-make-good-predictions-about-future-health-care-spending/2011/08/25/gIQADBpM3R_blog.html.

18. *See* Alex Forrest & Mustafa Konca, Autonomous Cars and Society (May 1, 2007) (unpublished undergraduate paper), *available at* http://www.wpi.edu/Pubs/E-project/Available/E-project-043007-205701/unrestricted/IQPOVP06B1.pdf; *see also* Tyler Cowen, *Can I see Your License, Registration and C.P.U.?*, N.Y. TIMES, May 28, 2011, at BU5 (discussing the possible societal benefits and costs of autonomous cars).

19. Debra Cassens Weiss, *Who's Liable for a Driverless Car Accident? Google Test Raises the Issue*, ABA J. (Oct. 12, 2010, 8:35 AM), http://www.abajournal.com/news/article/whos_liable_for_a_driverless_car_accident_google_test_raises_the_issue.

20. *See* Ackerman, *supra* note 5.

21. *See, e.g.*, Smith, *supra* note 4 ("Who *drives* an automated vehicle? The answer might be no one—a truly driverless car in the legal and technical senses. It might be a natural person—the individual owner (if there is one), the occupant (ditto), or the individual who initiates the automated operation (ditto again). It might be a company—the corporate owner, the service provider, or the manufacturer. Depending on the context, it might even be some combination of these possibilities.").

22. *See* Harold P. Green, *Nuclear Power: Risk, Liability, And Indemnity*, 71 MICH. L. REV. 479, 481-482 (1972) (identifying the nuclear industry's nascence and potential for harm).

23. *Id.*

24. *Id.* at 483.

investment in nuclear energy.[25] Establishing a similar insurance program for manufacturers of autonomous cars and technology would arguably produce similar results.

Section II will explore the technology and inner-workings of autonomous cars and examine other autonomous transportation technologies, including elevators, airplanes, sea vessels, and trains. It will also explore how courts evaluate harm caused by autonomous transportation technologies. Section III will apply tort law, products liability, and strict liability to autonomous cars. It will also analogize the biotechnology industry to autonomous cars and investigate the potential social utility of autonomous cars. Moreover, Section III will explain the logic behind the rise in products and strict liability claims against manufacturers of autonomous technology and cars. Lastly, Section IV will propose a new insurance framework that works in conjunction with current tort law in order to govern the liability of autonomous car manufacturers.

II. BACKGROUND

A. *How Do Autonomous Cars Work?*

The technology utilized in autonomous cars is a combination of computers, software, and sensing hardware that communicate with each other, the car, and in some cases, the human operator.[26] Sensing

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25. *See* U.S. NUCLEAR REGULATORY COMM'N, FACT SHEET ON NUCLEAR INS. AND DISASTER RELIEF FUNDS (2011), *available at* http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/funds-fs.pdf [hereinafter FACT SHEET ON NUCLEAR INS.].

26. *Computer Scientists And Engineers Design A Car Driven By Computers*, SCIENCEDAILY (Dec. 1, 2007), http://www.sciencedaily.com/videos/2007/1205-driverless_car.htm (discussing how autonomous car technology works) [hereinafter *A Car Driven By Computers*]; *see also* R. LOPES, PROJECT PAPER ON AUTONOMOUS CAR CONTROLLER 2-6 (2002), *available at* http://web.njit.edu/~rlopes/Project-example-1.pdf (describing the complete system of an autonomous car based on vision); *see also* Kate Greene, *Stanford's New Driverless Car*, TECHNOLOGYREVIEW (June 15, 2007), http://www.technologyreview.com/read_article.aspx?id=18908 ("The new car has a total of eight LIDAR systems that emit beams of light and detect reflections to determine the distance of other objects. One system is mounted on the front of [the car's] roof and has a range of about 100 meters . . . [a]nother LIDAR system points at the ground and constantly keeps track of the road and reflective lane markers. A third system constantly takes a 360-degree image of its surroundings. All this data is process by two Intel quad-core machines running at 2.3 gigahertz, and the pertinent information is relayed to the driving systems, which guide the car. [The car] is also equipped with a precise location system that include GPS and other sensors that measure the revolution of the wheels and the direction the car is moving in.

hardware usually includes some amalgamation of radar, lasers, lidar,[27] ultrasonic sensors, cameras, global positioning systems ("GPS"), and computers.[28] Sensing hardware creates data based on the surrounding environment of the car and sends that data to the computer.[29] The computer has software that applies logic-based, decision-making algorithms to the data provided by the sensing hardware.[30] Based on the environmental data and algorithms, this software provides data outputs to the car, which instructs it to make automated movements including acceleration.[31]

Currently, most autonomous car technologies available for use on public roads require human intervention.[32] For example, Lexus's advanced parking guidance system requires a human driver to align the vehicle with the desired spot, manually activate the autonomous parking technology, and engage the brakes to deactivate the autonomous parking technology once the maneuver is complete.[33]

Together, these sensors allow [the car] to pinpoint its location to within 30 centimeters.").

27. *See Using Lasers to Study our Atmospheres,* NASA (Aug. 1996), http://www.nasa.gov/centers/langley/news/factsheets/LaserSensing_prt.htm ("A lidar is similar to radar, which is commonly used to track everything from airplanes in flight to thunderstorms. Instead of bouncing radio waves off its target, however, a lidar uses short pulses of laser light to detect particles or gases in the atmosphere. Traveling as a tight, unbroken beam, the laser light disperses very little as it moves away from its origin—such as from space down to the Earth's surface. Some of the laser's light reflects off of tiny particles—even molecules—in the atmosphere. The reflected light comes back to a telescope and is collected and measured. By precisely timing the collected light, and by measuring how much reflected light is received by the telescope, scientists can accurately determine the location, distribution and nature of the particles [which creates a 3D image].").

28. Forrest & Konca, *supra* note 18, at 4-6 (providing a chart labeled Figure 1 detailing the process by which autonomous cars work); *see also A Car Driven By Computers*, *supra* note 26.

29. *A Car Driven By Computers*, *supra* note 26.

30. Forrest & Konca, *supra* note 18, at 5; *see also A Car Driven By Computers*, *supra* note 26 ("The car can steer, brake and accelerate, as well as turn all its components on or off, solely through its computer.").

31. *A Car Driven By Computers*, *supra* note 26.

32. Forrest & Konca, *supra* note 18, at 15.

33. *Advanced Parking Guidance System*, LEXUS (2012), http://www.lexus.com/models/LS/features/exterior/advanced_parking_guidance_system.html; *see also Demos Advanced Parking Guidance System*, LEXUS, (2012), http://www.lexus.com/models/LS/features/exterior/advanced_parking_guidance_system.html?demo=ls_parking&s_ocid=30019 (describing further how drivers engage the Advanced Parking Guidance System); Charles J. Murray, *Lexus LS 460 Parking System Grabs the Wheel*, DESIGNNEWS (Feb. 7, 2007),

This technology utilizes six sonar sensors, advanced ParkMate software, and computer processors.[34] Another example of an autonomous technology is adaptive cruise control, which controls a car's position relative to the location of the objects around it.[35] Adaptive cruise control uses either lasers or radar to determine both the location and speed of the vehicle in front of it, and the cruise control employs computer software to calculate the rate of acceleration required by the engine to maintain the specified distance between the vehicles.[36] An additional type of autonomous technology is the lane-keeping assist system.[37] The lane-keeping assist system helps the driver stay within the lanes by providing miniscule amounts of "actuation"[38] to the steering.[39] Radar, lidar, ultrasonic range finders, video cameras, and computer processors all work in conjunction to detect the lane's location.[40] Once the lane's location is determined relative to the car's current location, the computer relays the calculations to the steering system to maintain the car's location within the lane.[41] Although these autonomous car technologies are relatively new, car manufacturers are already in the developmental and testing stages, creating cars that are smarter and more independent of humans than ever before.[42]

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http://www.designnews.com/document.asp?doc_id=224411 ("When drivers want to parallel park the new vehicle, they are required to pull the LS past, and three feet away from, parked vehicles on the side, finally reaching a point where they can see the front license plate of the vehicle they plan to park behind. They then shift the transmission to reverse and press a "reverse icon" on a dashboard display.").

34. Murray, *supra* note 33.

35. Forrest & Konca, *supra* note 18, at 21.

36. *Id.*

37. *Id.* at 18.

38. *See generally,* Andreas Eidehall, *An Automotive Lane Guidance System* 4, (2004) (unpublished Ph.D. thesis, Linköpings Universitet), *available at* http://www.control.isy.liu.se/research/reports/LicentiateThesis/Lic1122.pdf (explaining actuation).

39. Forrest & Konca, *supra* note 18, at 18; *See, e.g.*, LANE KEEPING ASSIST, LEXUS (2011), http://web.archive.org/web/20110102093821/http://www.lexus.eu/range/Ls/key-features/safety/safety-lane-keeping-assist.aspx (providing a video and a description regarding the lane keeping assist feature).

40. Forrest & Konca, *supra* note 18, at 18.

41. *Id.*

42. Daniel H. Wilson, *Cars are approaching 'auto' pilot mode*, NBCNEWS.COM (Nov. 6, 2009, 9:13 AM), http://www.msnbc.msn.com/id/33591971/ns/technology_and_science-innovation/t/cars-are-approaching-auto-pilot-mode/#.TrsOsmCFLJ4

For instance, Volkswagen is currently developing Temporary Auto Pilot ("TAP") technology.[43] TAP can "semi-autonomously" drive a car on a clearly marked road up to speeds of approximately eighty miles per hour.[44] TAP does require a human to monitor the car in the same manner as if he was driving it, which is a limitation that some critics have noted in calling into question the usefulness of TAP.[45] However, Volkswagen's chief focus behind the development of TAP is improving safety because computers have substantially faster reaction times than humans.[46] While TAP seems complicated, it is merely a combination of autonomous technologies already available, such as adaptive cruise control and side monitoring.[47] Like many other autonomous technologies, TAP uses radar, cameras, ultrasonic sensors, a laser scanner, and an electronic horizon.[48]

Similarly, Google has developed its own fleet of semi-autonomous Toyota Prius automobiles that have logged more than 190,000 miles

(discussing how "semi-autonomous safety features" are allowing "the drivers to do less and less").

43. Mark Hachman, *Volkswagen Develops Self-Driving Car, Almost*, PCMAG.COM (June 23, 2011, 10:16 PM), http://www.pcmag.com/article2/0,2817,2387524,00.asp#fbid=yqNgBD7Lfln. (discussing Volkswagen's new semi-autonomous driving system, called "Temporary Auto Pilot (TAP)").

44. *Id.*

45. *Id.*; *see also* Evan Ackerman, *Volkswagen's Temporary Auto Pilot Makes Your Car Almost But Not Quite a Robot*, IEEESPECTRUM (June 28, 2011), http://spectrum.ieee.org/automaton/robotics/artificial-intelligence/volkswagen-temporary-auto-pilot-makes-your-car-almost-but-not-quite-a-robot. (discussing how the driver still has to pay attention to the car driving, which takes away the benefit from using the TAP system - the driver cannot divert his or her attention to other tasks).

46. *Id.*

47. Rebecca Boyle, *Volkswagen Debuts Self-Driving 'Temporary Autopilot' For New Cars*, POPSCI (June 24, 2011, 2:50 PM), http://www.popsci.com/cars/article/2011-06/volkswagen-debuts-self-driving-temporary-autopilot-new-cars; *See, e.g.*, SIDE ASSIST, VOLKSWAGEN (2011), http://www.volkswagen.co.uk/technology/proximity-sensing/side-assist (providing a video that explains side monitoring).

48. Hachman, *supra* note 43; *See also NAVTEQ(R) Electronic Horizon Technology Supports Dynamic Pass Predictor*, PRNEWSWIRE (Aug. 14, 2006), http://www.prnewswire.com/news-releases/navteqr-electronic-horizon-technology-supports-dynamic-pass-predictor-56122182.html ("NAVTEQ's patented electronic horizon technology enables the attributes in the NAVTEQ digital map to be used to assist the vehicle in understanding the road ahead.").

with limited human intervention in a diverse array of environments.[49] Like the Volkswagen TAP technology, the Google Prius cars use four radars, a camera, and a laser.[50] The laser works by generating a three-dimensional map of the car's surrounding environment and subsequently applies that map to existing maps to produce data.[51] The Google Prius also employs GPS and inertial measurement units[52] to determine its location and record its movements.[53] The Google Prius automobiles, furthermore, analyze past-recorded data from other vehicles that drove in the same location, and then incorporate such data into its decision-making processes.[54] Google's technology is arguably nearing the threshold of artificial intelligence ("AI"), which makes future decisions based on past experiences.[55] Although Google's software is advanced by today's standards, the software required for a fully autonomous vehicle is beyond what is readily available in the high-technology market.[56] The technology needs to

49. Erico Guizzo, *How Google's Self-Driving Car Works*, IEEESPECTRUM (Oct. 18, 2011), http://spectrum.ieee.org/automaton/robotics/artificial-intelligence/how-google-self-driving-car-works; *See also* John Markoff, *Google Cars Drive Themselves, in Traffic*, N.Y. TIMES, Oct. 10, 2010, at A1. (discussing how one of Google's autonomous Prius's drove down "Lombard Street in San Francisco," which is "one of the steepest and curviest streets in the nation").

50. Guizzo, *supra* note 49.

51. *Id.*

52. *See, e.g.*, *TheCrista IMUThe*, CLOUD CAP TECHNOLOGY, http://www.cloudcaptech.com/crista_imu.shtm. (last visited Nov. 2, 2011) (discussing what constitutes an inertial measurement unit).

53. Guizzo, *supra* note 49.

54. *Id.* ("The second thing is that, before sending the self-driving car on a road test, Google engineers drive along the route one or more times to gather data about the environment. When it's the autonomous vehicle's turn to drive itself, it compares the data it is acquiring to the previously recorded data, an approach that is useful to differentiate pedestrians from stationary objects like poles and mailboxes.").

55. Jennifer Valentino-DeVries, *Q&A: What Is Artificial Intelligence?*, WALL ST. J. (Jul. 14, 2010, 3:14 PM), http://blogs.wsj.com/digits/2010/07/14/qa-what-is-artificial-intelligence/ ("The theory is that computers can be programmed to learn from their decisions and move quickly in response to that learning.").

56. Forrest & Konca, *supra* note 18, at 5; *see also* Markoff, *supra* note 15, at B6 ("And despite Google's early success, technological barriers remain. Some trivial tasks for human drivers—like recognizing an officer or safety worker motioning a driver to proceed in an alternate direction—await a breakthrough in artificial intelligence that may not come soon.").

improve its reactions to the unpredictability of extremely dynamic environments, particularly in urban locations.[57]

It is imperative to understand how the autonomous technologies work at the piecemeal level in order to appreciate how liability is imposed on the manufacturers of autonomous technologies or cars via tort law. The next section will examine other modes of autonomous transportation, such as elevators, airplanes, sea vessels, and trains, and explore the legal frameworks that courts apply to these types of autonomous vehicles. These modes of transportation have utilized autonomous technologies for many years and may provide guidance on how to evaluate autonomous cars.

B. *The History and Liability Frameworks of Other Autonomous Vehicles*

1. Elevators

First commissioned by King Louis XV in the eighteenth century, elevators have evolved to the point where engineers are seriously considering an elevator beginning on the earth's surface and reaching into outer space.[58] Similar to airplanes and sea vessels, elevators are vehicles.[59] In the United States and Canada alone, 245 million people use elevators every day.[60] Despite elevators' current widespread usage and safety, elevators were traditionally unsafe, required a human

57. Forrest & Konca, *supra* note 18, at 5 ("Although the [autonomous car] prototypes seem to be very successful, a fully autonomous car that is reliable enough to be on the streets has not been constructed yet. This is mostly because of the difficulties involved in controlling a vehicle in the unpredictable traffic conditions of urban areas. While better hardware is being developed there are important limitations on the artificial intelligence side of the research. It would be fair to say that the future of the autonomous cars mostly depends on the development of better artificial intelligence software.").

58. K. Krasnow Waterman & Matthew T. Henshon, *Imagine the Ram-If-Ications, Assessing Liability for Robotics-Based Car Accidents*, 5 No. 4 A.B.A. SEC. SCIENCE &TECH, LAWYER Spring 2009, at14 (2009); *see generally*, D.V. Smitherman, Jr., *Space Elevators, An Advanced Earth-Space Infrastructure for the New Millennium*, NASA (Aug. 2000), *available at* http://www.nss.org/resources/library/spaceelevator/2000-SpaceElevator-NASA-CP210429.pdf (explaining all aspects of a space elevator); *see also* Bradley C. Edwards, Manuscript, *The Space Elevator*, NASA (2000), *available at* http://www.nss.org/resources/library/spaceelevator/2000-SpaceElevator-NIAC-phase1.pdf (a study on the concept of a space elevator).

59. Waterman & Henshon, *supra* note 58, at 3.

60. *Id.*

operator, and were powered by a steam pump.[61] The ropes often broke, making elevators unsuitable for people to ride in except for industrial use.[62] In 1854, however, Elisha Graves Otis introduced the first passenger-safe elevator.[63] Otis's elevator connected to guide rails instead of rope.[64] And since technology continued to progress quite rapidly, so did elevators.[65] Today, most elevators are fully autonomous and extremely efficient.[66]

Currently, state statutes and local ordinances govern elevator safety. The basis for most states' elevator codes and standards is found in both the American Society of Civil Engineers Code 21[67] and the American Society of Mechanical Engineers Safety Code A17.[68] In Ohio, all owners of elevators are required to register every elevator with the division of labor.[69] All passenger elevators require inspection twice a year by a competent inspector in order to remain in service.[70] Additionally, the Board of Building Standards establishes the parameters that govern the inspections of elevators.[71] But while

61. *Id.*; *see also Elevator*, ENCYCLOPÆDIA BRITANNICA, http://www.britannica.com/EBchecked/topic/184491/elevator (last visited Oct. 3, 2012, 7:43 PM).

62. *Elevator*, *supra* note 61.

63. Waterman & Henshon, *supra* note 58, at 3.

64. *Id.* at 3 ("[I]n front of a large crowd, [Otis] cut the elevator's rope causing his newly designed safety spring to lock the elevator in place."); *see also Elevator*, *supra* note 63.

65. *Elevator*, *supra* note 61.

66. *Id.*; *see also* John Tierney, *Smart Elevators, Dumb People*, N.Y. TIMES (Dec. 20, 2007, 12:48 PM), http://tierneylab.blogs.nytimes.com/2007/12/20/smart-elevators-dumb-people/?apage=3 (introducing the idea of smart elevators).

67. Waterman & Henshon, *supra* note 58, at 3 (setting forth the code "for people movers operated by cables").

68. *Id.* at 3-4 (referencing "the American Society of Mechanical Engineers Safety Code for Elevators and Escalators").

69. Ohio Rev. Code Ann. § 4105.09 (West 2012) (requiring each registration to "giv[e]the type, capacity, and description, name of manufacturer, and purpose for which each is used").

70. *Id.* at §§ 4105.02, 4105.10 (both discussing requirements of elevator inspections and inspector competency).

71. *Id.* at § 4105.011 ("Such rules shall prescribe uniform minimum standards necessary for the protection of the public health and safety and shall follow generally accepted engineering standards, formulae, and practices established and pertaining to such elevator design, construction, repair, alteration, and maintenance. The board may adopt existing published standards as well as amendments thereto subsequently published by the same authority.").

statutes exist for safety, they do not address liability when someone incurs injury or damage.

The cause of action for injuries resulting from a malfunctioning elevator is usually negligence.[72] The injured person can typically sue the landlord who owns the property where the elevator is located, the elevator manufacturer, or the elevator installer.[73] If a defect in an elevator's hardware is discovered, the injured plaintiff can sue the manufacturer based on products or strict liability.[74] For example, in *Ruiz v. Otis Elevator*, the door of the elevator prematurely closed on the plaintiff, causing her injury.[75] Service records indicated that there were issues with the door detectors in four specific instances.[76] The court of appeals held that the doctrine of *res ipsa loquitur* applied and that the jury could reasonably find a defect in the elevator.[77]

Elevators and autonomous cars are similar because technology dictates both vehicles' movement. However, elevators are distinguishable because they operate on closed tracks. Although there are mechanics in the elevator shaft that engage in action, the elevator's environment is not nearly as dynamic as an autonomous car's, particularly when the car is engaged in an ever-changing urban environment. Nevertheless, since technology controls an elevator's movements, elevators are similar enough to autonomous cars to illustrate that products liability or strict liability is probably applicable to autonomous cars when the autonomous technology causes harm.

2. Airplane Autopilot

Airplanes have utilized autopilots since about 1914, when Lawrence Sperry presented his gyroscopic stabilizer apparatus (the

72. Theresa L. Kilgore, *Cause of Action Injury or Death in Elevator or Escalator Accident*, 3 CAUSES OF ACTION 2D 461, § 1 (1993) (illustrating that the doctrine of *res ipsa loquitur* is applied often in elevator cases). *See, e.g.*, Knight v. Otis Elevator Co., 596 F.2d 84 (3d Cir. 1979) (finding the application of *res ipsa loquitur* valid as to what caused the elevator door to prematurely close); *see also* Ferguson v. Westinghouse Electric Corp., 408 So.2d 659 (Fla. App. 1981) (finding that *res ipsa loquitur* applied regarding the sudden dropping of an elevator).

73. *See* Kilgore, *supra* note 72, at § 2 ("[Although a] strict tort liability claim against the owner or occupier of the premises on which the elevator or escalator is located is unlikely to be successful.").

74. *Id.* (explaining that the injured plaintiff could also sue if it were found that a malfunction in the software caused the incident). *See infra* note 75.

75. 703 P.2d 1247, 1248-49 (Ct. App. 1985).

76. *Id.* at 1249 ("The elevator doors were equipped with a detector device which was supposed to stop the doors from closing on anyone . . . .").

77. *Id.* at 1251.

"Device") at the *Concours de la Securité en Aéroplane.*[78] Sperry designed and created the Device to improve both stability and control of airplanes.[79] The Device worked by "linking the control surfaces with three gyroscopes, allowing flight corrections to be introduced based on the angle of deviation between the flight direction and the original gyroscopic settings."[80] These early autopilots merely controlled the aircraft's pitch, yaw, and roll, which maintain the aircraft's "straight and level flight."[81] Today, autopilots execute complex maneuvers or flight plans, bring aircraft into approach and landing paths, or make possible the control of inherently unstable aircraft (such as some supersonic aircraft) and of those capable of vertical takeoff and landing.[82]

Modern autopilot systems are normally a combination of computers, sensing hardware, servomotors, and a guidance program.[83] The sensing hardware, "such as gyroscopes, accelerometers, altimeters, and airspeed indicators"[84] generate information based on the aircraft's surrounding environment.[85] The computers subsequently analyze the aircraft's location and motion with respect to the specified final destination, and command the servomotors to "actuate the craft's engines and control surfaces to alter its flight when corrections or changes are required."[86] Most autopilots work by making slight changes in the heading of the plane and do not require significant

78. Waterman & Henshon, *supra* note 58, at 1 ("[T]he autopilot was originally called a 'gyroscopic stabilizer apparatus,' and incorporated Sperry's insight that an autopilot needed to control three flight axes of an aircraft: yaw, pitch, and roll. The gyroscopes essentially offset movement in the aircraft through the air, opening or closing valves to change wing or rudder angles."); *see also Lawrence Sperry: Autopilot Inventor and Aviation Innovator*, HISTORYNET (June 12, 2006), http://www.historynet.com/lawrence-sperry-autopilot-inventor-and-aviation-innovator.htm [hereinafter *Autopilot Inventor*] (translating the "*Concours de la Securité en Aéroplane*" as the"Airplane Safety Competition").

79. *Autopilot Inventor*, *supra* note 78.

80. *Id.*

81. ENCYCLOPAEDIA BRITANNICA 2007 ULTIMATE REFERENCE SUITE, AUTOMATIC PILOT ("The earliest automatic pilots could do no more than maintain an aircraft in straight and level flight by controlling pitch, yaw, and roll movements; and they are still used most often to relieve the pilot during routine cruising.").

82. *Id.*

83. *Id.*

84. *Id.*

85. *Id.*

86. *Id.*

adaptations.[87] As a result, although there are many aircraft accidents on record, most are the result of human operating error and not autopilot manufacturing defects when the autopilot was in control.[88]

For instance, in *Richardson v. Bombardier, Inc.*,[89] a military airplane en route to Naval Air Station Oceana in Virginia went into a dive, broke apart, and crashed, killing all people on board.[90] The plaintiffs attributed the accident to a defect in the installation of the APS-65 autopilot system and a manufacturing defect in the APS-65.[91] The plaintiffs alleged that when the human pilot attempted to intervene, a "jam prevented the capstan from turning and, in turn, prevented the pilot from manually deflecting the elevator to resume level flight."[92] Nevertheless, the jury concluded that the APS-65 did not cause the crash.[93] On appeal, the court upheld the jury's conclusion and found that the plane itself was defective—not the autopilot.[94]

Similarly, in *Moe v. Avions Marcel Dasault-Breguet Aviation*, an airplane crashed resulting in the death of the pilots and several passengers, except one, who suffered "extensive, permanent injuries."[95] The plaintiffs contended that the crash resulted from, among other things, a defective autopilot system:

> [t]he evidence reflects that if a pilot engages the autopilot and then attempts to fly the aircraft manually with the autopilot

87. Waterman & Henshon, *supra* note 58, at 1.

88. *Id.* at 2.

89. No. 8:03CV544T31MSS, 2005 WL 3087864 (M.D. Fla. Nov. 16, 2005) *aff'd sub nom.* Ferguson v. Bombardier Serv. Corp., 244 F. App'x 944 (11th Cir. 2007).

90. *Id.* at *1; Waterman & Henshon, *supra* note 58, at 2 ("[A]n Army National Guard pilot engaged the autopilot on the C-23B that he was flying to go to the lavatory in the rear of the plane. While he was away, the plane hit a wind shear 'that caused [the plane] to pitch upward and gain altitude' by driving the nose of the plane upward. The autopilot attempted to adjust by lowering the elevator. But the autopilot's actions essentially overcorrected, and the plane went into a dive. As the court found, 'shortly thereafter, the increasing airspeed exceeded the structural limitations of the airplane, which broke apart and crashed.'").

91. *Richardson*, 2005 WL 3087864, at *1; Waterman & Henshon, *supra* note 58, at n.17 ("The *Richardson* court also rejected claims that the autopilot system was negligently designed, including a warning to notify a pilot when the autopilot has 'limit[ed] the amount of torque which can be applied to the controls.'").

92. *Richardson*, 2005 WL 3087864, at *3.

93. *Id.* at *6.

94. Waterman & Henshon, *supra* note 58, at 2.

95. 727 F.2d 917, 920 (10th Cir. 1984).

> engaged, the autopilot causes the plane to respond opposite to the pilot's control inputs. There is no clear warning that the autopilot is still engaged after the pilot attempts to disengage it by use of the yoke disconnect switch. Plaintiffs' evidence was that the stiffness of Arthur Q runaway, or hydraulic clogging, masked and camouflaged the fact that the autopilot had not disengaged.[96]

The experts for both the plaintiffs and defendants presented mixed opinions on whether the autopilot caused the crash.[97] Nonetheless, the appeals court upheld the unanimous jury verdict in favor of the defendant regarding the autopilot products liability claims.[98]

In cases where the autopilot on airplanes allegedly caused harm, the plaintiffs have sued under a products liability claim. Furthermore, most airplane crashes are not the result of autopilot malfunctions.[99] The Code of Federal Regulations bars the use of autopilot systems below an altitude of five hundred feet.[100] Because human pilots are in control of the airplane during takeoff and landing, the likelihood of operator error increases substantially since humans have slower reaction times than computers.[101] Even when the autopilot is activated and in control of the airplane during flight, the human pilots are supposed to monitor the autopilot and determine if a manual override is necessary, further supporting the contention that

96. *Id.* at 921.

97. *Id.* at 921-22.

98. *Id.* at 922-23, 936.

99. Waterman & Henshon, *supra* note 58, at 3 ("[M]ost airplane accidents involve departures or landings, which are generally not when autopilots are in use.").

100. FAA Operating Requirements Rule, 14 C.F.R. § 121.579 (2007) ("Except as provided in paragraphs (b), (c), and (d) of this section, no person may use an autopilot en route, including climb and descent, at an altitude above the terrain that is less than twice the maximum altitude loss specified in the Airplane Flight Manual for a malfunction of the autopilot under cruise conditions, or less than 500 feet, whichever is higher."); *see also* In re Korean Air Lines Disaster of Sept. 1, 1983, 932 F.2d 1475 (D.C. Cir. 1991) (finding the crew and not the autopilot at fault when the airplane flew into restricted USSR airspace and was shot down); *see also New Jersey Federal Jury Returns Defense Verdict In Suit Alleging Defective Autopilot*, 228 PRODUCTS LIABILITY ADVISORY ART. 5-6 (Feb. 2008) (finding the manufacturer of the autopilot not liable because sufficient facts existed to show that the autopilot did not malfunction and that the pilot was impaired during the fatal flight).

101. *See* Ackerman, *supra* note 45 ("[A] car is still about a thousand times quicker than [a person] when it comes to reaction times.").

human error causes far more accidents than autopilot technology.[102] Since autopilot technology is rarely at fault for airplane crashes, products and strict liability suits do not undermine the advancement of autopilot technology in the marketplace. Therefore, there is no need to afford manufacturers of airplane autopilots special treatment. Although airplane autopilots and autonomous cars are distinguishable, they are similar enough to show that products and strict liability will probably be applied to autonomous cars in the future when the autonomous technology is alleged to have caused damage.

3. Sea Vessel Autopilot

Sea vessel autopilots consist of five basic parts that control the vessel's speed, rudder, and generally compensate for the vessel's environment.[103] Generally, the control panel, computer, heading sensor, rudder drive, and rudder position sensor all work in conjunction to navigate the vessel to the specified location.[104] As with airplane accidents, human operator error seems to play a major role in sea vessel accidents where autopilots were active.[105] For instance, in 2009 a twenty-one foot vessel crashed into a breakwall on Lake Erie.[106] According to the Ohio Department of Natural Resources, the owner of the vessel entered wrong coordinates into the autopilot, which caused the crash.[107]

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102. Waterman & Henshon, *supra* note 58, at 2 ("[C]onstant human oversight is both implied and expected, to determine whether then-current use of the autopilot is appropriate.").

103. Chuck Husick, *Autopilots by the Dozen*, YACHTING MAGAZINE (Oct. 3, 2007), http://www.yachtingmagazine.com/article/Best-New-Autopilots (describing the five basic parts as "the operator control panel, the computer (which may be built into the control panel), the heading sensor, rudder drive and, in virtually all installations, a rudder-position sensor").

104. *See id.* ("A properly chosen, installed and operated autopilot will eliminate the tedium of steering, making your time underway more enjoyable. By precisely controlling your yacht's rudder, the autopilot will allow you to maintain the high degree of situational awareness needed to assure safe navigation.").

105. *See* Ron Rutti, *Error using GPS system blamed for Conneaut boating accident*, CLEVELAND.COM (Aug. 10, 2009, 10:36 AM), http://blog.cleveland.com/metro/2009/08/a_boating_accident_that_left.html; *see also* Waterman & Henshon, *supra* note 58, at 2.

106. Rutti, *supra* note 105; a "breakwall" is generally defined as a manmade wall in the lake constructed with the purpose of protecting the land from waves.

107. *Id.*

Similarly, in 2006, the captain of the *Crown Princess* cruise ship engaged the autopilot too early after leaving port.[108] As a result, the autopilot attempted to turn the cruise ship at a dangerously high speed in shallow water.[109] The second officer attempted to intervene; however, he overcompensated and the cruise ship breeched, resulting in over three hundred passengers sustaining injuries.[110] The National Transportation Safety Board released a report stating that the second officer's "incorrect wheel commands" caused the accident.[111] However, the report also recommended that Sperry Marine, the company that manufactured the autopilot, "develop a system that provides [the crew of a vessel] with critical information regarding errors or potential problems in the use of integrated navigation systems."[112]

Likewise, the 2012 Costa Concordia cruise ship accident was also the result of human error, according to the media and Costa Cruise, the cruise line that owns the ship.[113] Pier Luigi Froshi, the Chief Executive Officer of Costa Cruise, said "'[o]f course our ships have autopilot, which immediately sends a warning signal when the ship goes off course . . . .' But the Costa Concordia was being steered manually when it crashed. 'And they didn't see the obstacle, a row of rocks extending from the land into the sea.'"[114]

However, there are also instances where defective autopilots allegedly caused injuries. In *Boucvalt v. Sea-Trac Offshore Services, Inc.*, the plaintiff alleged that the autopilot on his yacht malfunctioned and caused an impact.[115] The plaintiff pled, among other things, a plethora of products liability allegations pertaining to the manufacturing of the autopilot.[116] The plaintiff argued that the

108. Waterman & Henshon, *supra* note 58, at 2.

109. *Id.*

110. *Id.*

111. Nat'l Transp. Safety Bd., *Heeling Accident on M/V Crown Princess Atlantic Ocean Off Port Canaveral, Florida July 18, 2006*, NAT'L TRANSP. SAFETY BD. ACCIDENT REPORTS (Jan. 30, 2008), *available at* http://www.ntsb.gov/doclib/reports/2008/MAR0801.pdf.

112. *Id.*

113. *Cruise Ship Hit Rocks Above Water's Surface, Not Below, Ship Official Says,* INT'L HERALD TRIB. (Jan. 21, 2012, 9:43 AM), http://rendezvous.blogs.nytimes.com/2012/01/21/cruise-ship-hit-rocks-that-were-above-not-below-surface-ship-official-says/.

114. *Id.*

115. 943 So. 2d 1204, 1205 (La. Ct. App. 2006) ("This lawsuit arises out of an collision in the Gulf of Mexico between the 40-foot yacht Slick Liquor and a well jacket owned by Chevron, USA.").

116. *Id.* at 1208 ("The allegations against Raymarine can be summarized as failure to adequately test the product before it went to market, failure to warn, failure to conduct sufficient testing on the product's

autopilot manufacturer knew about the issues with the fluxgate compass, yet failed to test it for defects.[117] The appellate court found nothing beyond negligence and affirmed the trial court's dismissal.[118]

As demonstrated in *Boucvalt*, plaintiffs in sea vessel autopilot cases will most likely bring products or strict liability claims, just like plaintiffs in aircraft autopilot cases. And although navigating a sea vessel is more analogous to driving on land in the sense that land and water are more concentrated with potential obstacles than flying an airplane—navigating on water is not as dynamic as driving on land—especially in an urban setting. In addition, sea vessel autopilots are only active when the vessel is out to sea and not in shallow waters, just as airplane autopilots are only active while in flight.[119] Moreover, sea vessels, like airplanes, the Google Prius automobiles, and Volkswagen TAP, also require someone to monitor the autopilot system at all times.[120] Nevertheless, since autopilot technology is sometimes in control of both airplanes and sea vessels, these analogies still provide guidance on how courts will view autonomous cars.

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components, breach of express and implied warranties, and failure to adequately communicate installation guidelines to its dealers, etc.").

117. *Id.* at 1208-09 ("[P]laintiffs point out the deposition testimony of three witnesses, Dr. John Kreifeldt, Carl Busuttil-Reynaud, and Christopher Martin. Plaintiffs argue that these witnesses' testimonies establish that Raymarine knew about erratic behavior of the fluxgate compass when a vessel using the autopilot passed large metal objects; Raymarine declined to perform hazards testing on the flux gate compass component of the auto pilot, and knew about problems with the flux gate compass, but did not investigate further until this litigation. This Court notes that in the deposition testimony of Reynaud, the statement plaintiffs rely on was taken out of context. This witness testified that the entire auto pilot system was tested, of which the flux gate compass was a component, though no testing was performed on the flux gate compass individually and separate from its function within the autopilot system, because the flux gate compass was a known technology at the time. Plaintiffs do not allege that no testing was performed.").

118. *Id.* at 1205-09 ("The trial court found that the allegations in plaintiffs' petition did not rise past ordinary negligence, and accordingly dismissed that cause of action. Plaintiffs appeal. We affirm the judgment of the trial court. . . . [t]he trial court was correct in its ruling that plaintiffs' allegations of Raymarine's negligence did not rise to reckless or callous disregard for the rights of others, or gross negligence."). The plaintiff wanted punitive damages, so he argued for a higher standard, *i.e.*, gross negligence or reckless disregard, but both the trial and appellate courts found only negligence. There is no subsequent history and the opinion provided no analysis on how negligence was found. Moreover, the trial court dismissed both parties with prejudice.

119. Waterman & Henshon, *supra* note 58, at 2.

120. *Id.*

4. Autonomous Trains

On November 4, 2011, Paris commissioned its first fleet of autonomous trains.[121] However, fully autonomous trains are not new;[122] in fact, Chicago's O'Hare airport has operated autonomous trains since 1993.[123] Additionally, in 2008, Miami International Airport commissioned Mitsubishi to build a "driverless people mover system."[124] Yet just months after the driverless people mover system was fully installed, it was involved in an accident.[125] According to a report by the National Transportation Safety Board, a three-car train failed to stop at a specified platform and crashed into a wall at the end of the guideway, injuring seven people.[126] The train was in fully automatic mode—without a human operator—when the accident occurred.[127] The National Safety Transportation Safety Board's report concluded that the train's software malfunctioned and that human error did not cause the accident.[128] Although there are insufficient facts to determine if products liability or strict liability

121. Bryan Pirolli, *Paris metro makes conversion to driverless trains*, SMARTPLANET.COM (Nov. 4, 2011, 1:35 AM), http://www.smartplanet.com/blog/global-observer/paris-metro-makes-conversion-to-driverless-trains/432.

122. *Germany's First Driverless Mass-Transit Train Goes to Work*, THAINDIAN.COM (May 4, 2008, 11:19 AM), http://www.thaindian.com/newsportal/world-news/germanys-first-driverless-mass-transit-train-goes-to-work_10045075.html ("Germany's first driverless mass-transit train went into operation Sunday without fanfare in the southern city of Nuremberg, with a computer in charge for the whole day. Driverless trains are already in use in other nations, including the Singapore's North East Metro Line (NEL) operating since 2003 . . . .").

123. Gary Washburn, *O'Hare Set To Really Move You*, CHI. TRIB. (May 6, 1993), http://articles.chicagotribune.com/1993-05-06/news/9305060221_1_people-mover-westinghouse-electric-corp-airport-transit-system.

124. *Mitsubishi Heavy to Build Miami Airport Transit-Report*, REUTERS (Oct. 2, 2008, 4:41 PM), http://www.reuters.com/article/2008/10/02/mitsubishi-miamiairport-idUSN0229579720081002.

125. Nat'l. Transp. Safety Bd., *Railroad Accident Report: Board Meeting - Miami, FL/Miami-Dade Airport Transit Shuttle Crash*, NAT'L/ TRANSP. SAFETY BD. (Nov. 28, 2011), http://www.ntsb.gov/news/events/2011/miami_fl/index.html.

126. *Id.*

127. *Id.*

128. *Id.* ("The . . . train failed to make a normal deceleration and stop at its station platform berthing point because of the failure . . . within the program stop system module.").

applies, there is no doubt that if there was a malfunction in the hardware or software, a manufacturing defect may have been present. Even so, autonomous trains also crash as a result of human operating error.[129] For example, human operating error caused a 2006 autonomous train accident in Germany, killing twenty-three people.[130]

Autonomous train case law also seems to dictate a products and strict liability theory of recovery in the case that autonomous train technology causes injury. For instance, in *In re Fort Totten Metrorail Cases Arising Out of the Events of June 22*, two trains collided resulting in several deaths.[131] The plaintiffs alleged that since train number 112's automatic train control system failed to detect train number 214, the trains crashed.[132] Particularly,

> [a]round 2004, the WMATA [Washington Metro Area Transit Authority] began replacing GRS components with those provided by United Switch & Signal . . . The use of both GRS and U.S. & S components allegedly diminished the sensitivity of the train detection system, resulting in the track circuit not de-energizing as it should have to detect the presence of a train on the track.[133]

The plaintiffs pled, among other things, products liability.[134] The plaintiffs alleged a failure "to properly design, manufacture, install, inspect, test, and maintain the automated warning system that should have prevented the two trains from colliding."[135] The court, however, found that the defendants were protected by the District of Columbia's repose statute.[136] As a result, the plaintiffs' products

129. *See Deadly Crash on German Monorail*, BBC (Sept. 22, 2006, 11:28 PM), http://news.bbc.co.uk/2/hi/europe/5370564.stm.

130. *Id.*

131. 793 F. Supp. 2d 133, 137 (D.C.C. 2011).

132. *Id.*

133. *Id.* at 138.

134. *Id.* ("Both the Master Complaint and the McMillan Estate Complaint raise claims of negligence, products liability, and breach of warranty against defendant.").

135. *Id.* ("The claims primarily allege that malfunctions in the electronic train control system caused the crash. Alstom, as one of the providers of the components used in the electronic train control system, is alleged to have failed to properly design, manufacture, install, inspect, test, and maintain the automated warning system that should have prevented the two trains from colliding.").

136. *Id.* at 137 ("They allege that because Alstom is a manufacturer, excluded from protection under the statute of repose, its activities as both a designer and manufacturer must be excluded from protection.").

liability claims were dismissed.[137] It is not a surprise that the plaintiffs alleged products liability in this context. Autonomous trains are analogous to elevators, except that autonomous trains operate on a horizontal axis instead of a vertical axis.

As evidenced by the illustrations and case law, whenever autonomous technology is controlling a means of transportation and causes harm or damage, the plaintiffs bring products or strict liability claims against the manufacturer. This finding is essential in making a reasonable prediction on how courts will analyze autonomous car liability. Since courts consistently apply products or strict liability to these autonomous vehicles, courts will most likely treat autonomous cars similarly. Policy considerations, moreover, mandate that manufacturers of autonomous cars do not deserve different treatment in the application of products or strict liability when the autonomous cars are the sole cause of the harm.[138] This result, however, is problematic. Since human error is non-existent in cases where autonomous cars are the cause of the harm, courts will apply products and strict liability. This application effectively increases manufacturer liability, thereby hampering the entrance of autonomous cars into the marketplace due to the manufacturer's lack of monetary incentives.[139]

The following section will provide an in-depth background and analysis of negligence, products liability, and strict liability. It will then analogize the biotechnology industry to autonomous cars, explore the potential social utility of autonomous cars, and provide reasoning why manufacturers of autonomous cars and technology will see an uptick in products liability claims.

III. THE CURRENT LIABILITY FRAMEWORK AND ITS INHERENT DEFECTS

A. *General Tort Law*

Tort law governs the liability of vehicles controlled by humans. Particularly, when an unintentional tort occurs, negligence governs

137. *Id.*

138. Restatement (Second) of Torts § 402A cmt. c (1965) ("[P]ublic policy demands that the burden of accidental injuries caused by products intended for consumption be placed upon those who market them, and be treated as a cost of production against which liability insurance can be obtained.").

139. *See* LeBeau, *supra* note 15 ("Strip away the marketing and auto shows there is one ultimate goal for the automakers: make the most money possible on each automobile.").

the person's liability.[140] Generally, to find someone liable for negligence, the plaintiff must first establish that the defendant owed him a duty or obligation.[141] Second, the plaintiff must prove that the defendant breached that duty or obligation.[142] Third, the plaintiff is required to present evidence showing that the defendant's conduct was the proximate and "but for" cause of his injuries.[143] Lastly, the plaintiff must establish that he incurred an actual loss or damage as a result of the defendant's unreasonable conduct.[144]

In a situation where a human causes a car accident, the court will apply the four-element negligence test and decide whether the human is liable. However, issues arise when hardware or software causes all of the injury or damage. For example, imagine an autonomous car driving down a street. Suddenly, the car's autonomous software miscalculates the location of cars parallel-parked along the street, thereby causing it to crash into several of the parked vehicles, and substantial damage ensues. It is obvious that applying the current negligence test to hardware or software is not practical—no one would argue for imposing tort liability on a computer, its software, or autonomous car hardware—because one cannot literally impute liability on a machine.[145]

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140. *See generally*, ROBERT E. KEETON ET AL., PROSSER AND KEETON ON TORTS 161-64 (5th Ed. 1984) (providing a section on the history and generalities of negligence).

141. *Id.* at 164 ("A duty, or obligation, recognized by law, requiring the person to conform to a certain standard of conduct, for the protection of others against unreasonable risk.").

142. *Id.* ("A failure on the person's part to conform to the standard required: a breach of duty.").

143. *Id.* at 165 ("A reasonably close causal connection between the conduct and the resulting injury . . . which includes the notion of cause in fact.").

144. *Id.* ("Since the action for negligence developed chiefly out of the old form of action on the case, it retained the rule of that action, that proof of damage was an essential part of the plaintiff's case.").

145. First, the software program by itself cannot compensate the car owners for the damage it caused, effectively undermining tort law's primary function—to compensate those who incur injury or damage as a result of other's unreasonable actions. *See* KEETON ET AL., *supra* note 140, at 5. Second, one of the integral pieces of the negligence analysis is deciding whether a "'reasonable [person] of ordinary prudence'" under like circumstances would have acted similarly. *Id.* at 174. Yet, this standard is not applicable to either hardware or software. Neither hardware nor software falls within the lay definition of a human being. JUDY PEARSALL ET AL., THE CONCISE OXFORD DICTIONARY 691 (10th Ed. 2002) (defining human being as "a man, women, or child of the species *Homo sapiens*."). And while the combination of software and hardware is somewhat analogous to a human's skeletal and central nervous systems, there is no standard by which one can determine how

Attributing liability to the owner of the vehicle, nevertheless, is not socially desirable,[146] unless owners of autonomous cars agree upon the purchase of the autonomous car to assume the risk of all harm, regardless of what, or who, caused it.[147] Yet, requiring consumers to assume one-hundred percent of the risk would deter many from purchasing autonomous cars—at least until the technology is extremely reliable. Since consumers have no power over the quality of autonomous car manufacturing, design, or spending, public policy concerns will likely outweigh an assumption of the risk approach that requires the consumer to accept total responsibility, regardless of fault.[148] While general tort law does not provide a course of action, products and strict liability does.

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either software or hardware must act or make decisions. Even if the software is so advanced that it can "think" like a human, neither hardware nor software possesses a human being's mental capacity, physical attributes, knowledge, or age, which are all required bricks in the wall of the reasonable person analysis. KEETON ET AL., *supra* note 140, at 165, 175-179. Moreover, the reasonable person doctrine dates as far back as 1837. Vaughan v. Menlove, 1837, 3 Bing.N.C. 468, 132 Eng.Rep. 490 ("Instead therefore, of saying that the liability for negligence should be co-extensive with the judgment of each individual, which would be as variable as the length of the foot of each individual, we ought rather to adhere to the rule which requires in all cases a regard to caution such as a man of ordinary prudence would observe."). As a result, the framers of the reasonable person doctrine did not postulate the existence of software or hardware.

146. Under current negligence law, imputing liability upon the owner of the vehicle is not possible. The owner must act, or fail to act, giving rise to the harm. Here, the owner is merely a passive passenger. The car itself caused the harm via a malfunction. Under the current Nevada regulations, the operator, whether or not in the car, is considered the driver. As a result, the human owner could in theory be liable for the damage that the car's malfunctions caused.

147. KEETON ET AL., *supra* note 140, at 480 ("assumption of the risk has been recognized from three different perspectives, as follows . . . [i]n its most basic sense assumption of the risk means the plaintiff, in advance, has given his *express* [sic] consent to relieve the defendant of an obligation of conduct toward him, and to take his chances of injury from a known risk arising from what the defendant is to do or leave undone . . . . The result is the defendant is relieved of legal duty to the plaintiff; and being under no duty, he cannot be charged with negligence . . . . A second situation is where the plaintiff voluntarily enters into some relation with the defendant, with knowledge that the defendant will not protect him against one or more future risks that may arise from the relation. He may then be regarded as tacitly or *impliedly* [sic] consenting to the negligence and agreeing to take his own chances . . . . In the third type of situation, the plaintiff is aware of a risk that has already been created by the negligence of the defendant, yet chooses voluntarily to proceed to encounter it.").

148. *Id.* at 482 ("where one party is at such obvious disadvantage in bargaining power that the effect of the contract is to put [the consumer]

B. *Products and Strict Liability*

Products liability law, which can be traced back as far as the sixth century A.D. in Roman law,[149] is a specialized area of law that imposes liability upon manufacturers or suppliers of goods.[150] Products liability law is reactive in nature—its purpose is to compensate those injured due to a manufacturer's negligence in the production of a product—hence, it operates *ex post*.[151] Generally, anyone who sells or manufactures a product is liable for negligence if the product "may reasonably be expected to be capable of inflicting substantial harm if it is defective."[152] The rationale for holding product manufacturers liable is based on the economic benefit that the manufacturers derive from sales of the products they sell.[153] Products liability law has carved out several instances by which a manufacturer or creator of a product is subject to liability.[154]

A manufacturer, and sometimes others involved in the stream of commerce, may incur liability if it fails to discover a flaw in the product it is manufacturing or selling.[155] The plaintiff must show, by preponderance of the evidence, that the defect in question proximately caused his injuries.[156] Moreover, the plaintiff must establish that the defendant's conduct, when compared to a prudent manufacturer under like circumstances, is unreasonable.[157] Thus, if an

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at the mercy of the other's negligence. Thus it is generally held that a contract exempting an employer from all liability for negligence toward his employees [, for example,] is void against public policy.").

149. DAVID G. OWEN, ET. AL., PRODUCTS LIABILITY LAW 11 (2005).

150. KEETON ET AL., *supra* note 140, at 677.

151. OWEN ET AL., *supra* note 149, at 3.

152. KEETON ET AL., *supra* note 140, at 682-83 ("Cardozo's opinion struck through the fog of the 'general rule' and its various exceptions, and held the maker liable for negligence. This decision found immediate acceptance and at the end of some forty years is universal law in the United States.").

153. *Id.* at 683.

154. *Id.* at 685.

155. *Id.* ("A flaw in a product is a condition of the product that is different from what it was intended to be . . . . Normally, a retail dealer would not be negligent, as a matter of law, in selling a flawed or defectively designed product of a reputable manufacturer.").

156. Colon ex rel. Molina v. BIC USA, Inc., 199 F. Supp. 2d 53, 85 (S.D.N.Y. 2001) ("[T]he plaintiff must show that a specific product unit was defective as a result of 'some mishap in the manufacturing process itself, improper workmanship, or because defective materials were used in construction,' and that the defect was the cause of plaintiff's injury.") (citation omitted).

157. OWEN ET AL., *supra* note 149, at 440.

autonomous car's software fails due to an error in production—causing it to rear-end the car directly in front of it—the manufacturer or producer of the software is theoretically subject to liability as long as it acted unreasonably. In the area of manufacturing defects, it is typically not difficult for a plaintiff to prove that a product is defective, and therefore caused the harm, because that burden can be met through the use of expert testimony.[158] Consequently, most defendants settle in order to avoid the high costs and negative publicity that result from litigation.[159]

Manufacturers may also be liable for a failure to warn consumers about a danger or hazard[160] when a manufacturer knows or should have known about an inherent danger or hazard regarding its product.[161] This duty to warn is specifically rooted in Roman sales law.[162] If a merchant living in the Roman Empire sold a product with a hidden danger and did not provide notice of the hidden danger to the consumer, the merchant risked being found guilty of *dolus*, *i.e.*, fraud.[163] In the modern context, the manufacturer is held to a standard of reasonable inquiry.[164] Manufacturers are under a duty to adequately warn consumers of hidden dangers in their products; however, there is no duty to warn consumers about obvious dangers.[165] As such, if someone is harmed, yet the manufacturer sufficiently warned consumers of the danger that caused the harm, the manufacturer is not liable.[166] Moreover, a manufacturer is not subject to liability if the consumer used the product in an unforeseeable way,

158. *Id.* at 434, 39.

159. *Id.*

160. KEETON ET AL., *supra* note 140, at 677.

161. *Id.*

162. OWEN ET AL., *supra* note 149, at 562.

163. *Id.*

164. *See* KEETON ET AL., *supra* note 140, at 685 ("[I]t is the state of the scientific knowledge and technical information regarding danger that was available to the seller at the time such seller surrendered possession that is relevant and admissible as regards [to] what he should have known. The information which a manufacturer should have known would include information that would be obtainable from a reasonable inquiry of experts and a reasonable research of scientific literature.").

165. *See id.* at 686; OWEN ET AL., *supra* note 149, at 561 ("Manufacturers and other sellers have a duty to provide consumers with warnings of hidden product dangers and instructions on how their products may be safety used. Products that fail to carry sufficient informational 'software' of this type are deemed 'defective.'").

166. OWEN ET AL., *supra* note 149, at 561.

because it is not possible for the manufacturer to know of the danger and reasonably warn the consumer.[167]

Lastly, a manufacturer is subject to liability if the design of a product itself is defective in nature.[168] However, what constitutes a defective design is not clear.[169] Furthermore, many economists stand behind the theory that it is the market's role to decide which designs are inherently defective—not judges and juries.[170] In addition, many critics cite the fact that even if a manufacturer went to the most reasonable lengths in designing a product, the manufacturer may still incur liability, which should be against public policy.[171] Nevertheless, the law requires manufacturers to satisfy the duty of care when designing consumer goods.[172]

The risk-utility test, which gained popularity in the 1970s, is the leading legal test for whether a design is defective.[173] The test states that a product design is defective if "the costs of avoiding [a] particular hazard are foreseeably less than the resulting safety benefits."[174] In litigation, the plaintiffs and defendants generally argue over a "narrow '*micro-balance*' of pros and cons of a manufacturer's failure to adopt some particular design *feature* that would have

167. *See* KEETON ET AL., *supra* note 140, at 687 ("Thus in one case, a 5-year-old child sprinkled himself with highly flammable fingernail polish which had no warning. The child was burned to death when the polish ignited while he was playing with the polish. It was held that there was no duty to warn against this kind of misuse. But the real reason would appear to be that a warning of this kind of rare use would probably have served no purpose in most instances since those who read or could read would already know of the existence of the likely flammability of the product."); The same would probably apply to the misuse of autonomous cars—if you can read (implying you are educated), then you probably know what the reasonable uses of an autonomous car are.

168. OWEN ET AL., *supra* note 149, at 480.

169. *See id. at* 490 ("The quest for understanding design defectiveness perennially vexes courts and accomplished products liability lawyers attempting to unravel design defect problems; delights law clerks, young associates, and law students furnished an occasion for displaying their erudition; and provides fertile grist for law professors aspiring for the renown thought to follow discovery of the key riddle wrapped in a mystery inside an enigma.").

170. KEETON ET AL., *supra* note 140, at 688.

171. *Id.* ("[O]ne can be either negligent or without negligence in designing a bad product . . . .").

172. *Id.*

173. OWEN ET AL., *supra* note 149, at 493.

174. *Id.* at 495 ("In other words, if the safety benefits from preventing the danger that harmed the plaintiff were foreseeably greater than its precaution costs, the product's design is defective under the cost-benefit (or "risk-utility") standard of liability.").

prevented the plaintiff's harm."[175] Hence, in most defective design cases, the plaintiff tries to provide a superior alternative to the design the defendant used.[176] In many jurisdictions, the law often requires the plaintiff to present a superior alternative design in the pleadings.[177] And while design defectiveness is the leading claim set forth by plaintiffs today,[178] the leading theory that most plaintiffs assert in products liability litigation is strict liability.[179]

Starting in the 1960s, strict liability became the "predominant theory of recovery [in the United States] for product related injuries."[180] Originally, strict liability's basis was solely founded in contract law, via an implied or express warranty.[181] Subsequently, the torts theory of strict liability emerged, which is conditioned upon the inherent dangerousness of the product.[182] Regardless of the confusion surrounding strict liability in the context of products liability, state courts agree that "in order for strict liability to apply under Section

175. *Id.* at 498 ("[T]hat is, whether the costs of changing the design in some particular ('micro') manner would have been worth the resulting safety benefits.").

176. *Id.* at 505 ("[D]esign defectiveness is usually best resolved by the risk-utility analysis, the purpose of which is to determine 'whether the risk of injury might have been reduced or avoided if the manufacturer had used a feasible a alternative design.' In the words of a leading tort scholar, 'one simply cannot talk meaningfully about a risk-benefit defect until and unless one has identified some design alternative (including any design omission) that can serve as a basis for a risk-benefit analysis.'").

177. *Id.* at 506.

178. *Id.* at 482.

179. *Id.*

180. Michael D. Stovsky, Comment, *Product Liability Barriers to the Commercialization of Biotechnology: Improving the Competitiveness of the U.S. Biotechnology Industry*, 6 BERKELEY TECH. L.J. 363, 366 (1992).

181. *See* KEETON ET AL., *supra* note 140, at 690 ("Two problems in particular gave considerable trouble." First, a "buyer [is prevented] from recovering on a warranty unless he gives notice to the seller within a reasonable time after he knows or should know of the breach." Second, a manufacturers was "free to insert in his contract of sale an effective agreement that he warrants only against certain consequences or defects, or that his liability shall be limited to particular remedies, such as replacement, repair, or return of the purchase price.").

182. *See* KEETON ET AL., *supra* note 140, at 693-94 ("The first case to apply a tort theory of strict liability generally was Greenman v. Yuba Power Products, Inc., in California in 1963. That decision and the final acceptance of Section 402A of the Second Restatement of Torts by the American Law Institute in 1964 were immediately relied upon for the adoption of strict liability in tort throughout the country."); *see also id.* at 677-724 (further discussing strict liability).

402A [of the Second Restatement of Torts], [the] product[] [in controversy] must be 'in a defective condition unreasonably dangerous to the user or consumer.'"[183]

Automotive products liability is nearly identical to other types of products liability cases.[184] In some respects, nonetheless, automotive products liability is nuanced.[185] These cases normally involve either defects that cause accidents, or vehicles that are not "sufficiently 'crashworthy' to protect the occupants" in the car.[186] Plaintiffs normally plead that a design defect, failure to warn, or manufacturing defect caused the injury or harm to the plaintiff.[187]

It seems like products or strict liability is the best way for drivers to recover against manufacturers of autonomous cars when the cars' technology causes harm; however, policy and economic issues complicate the matter because the social utility of autonomous cars will be substantial once they enter the marketplace.[188]

C. Biotechnology: A Case Study

Applying products and strict liability, although legally sound, would have a hampering effect on the introduction of autonomous car technology into the marketplace.[189] For example, in the United

183. *See* Stovsky, *supra* note 180, at 367 ("In determining whether liability attaches to a defective product, state courts apply one of two distinct tests: (1) a risk-utility test, or (2) a consumer expectations test."); *see also* KEETON ET AL., *supra* note 140, at 702 (further discussing the consumer-contemplation tests and the risk-utility test).

184. OWEN ET AL., *supra* note 149, at 1073.

185. *Id.* at 1073.

186. *Id.* at 1072-73.

187. *Id.* at 1073.

188. *See infra*, Section III.D.

189. Tyler C. Folsom, *Social Ramifications of Autonomous Urban Land Vehicles* 4, IEEE INT'L SYMPOSIUM ON TECH. AND SOC'Y (May 2011), *available at* http://faculty.washington.edu/jbs/itrans/tyler-article.pdf; *see* Markoff, *supra* note 15, at B6 ("'Why would you even put money into developing it?' [Gary E. Marchant, director of the Center for Law, Science and Innovation at the Arizona State University Law School] asked. 'I see this as a huge barrier to this technology unless there are some policy ways around it'—though he noted that there were precedents for Congress adopting such policies."). The argument that the current torts regime only prevents dangerous or defective technologies from entering the marketplace is valid; however, a product's utility may substantially outweigh the product's risk, yet the profits do not overcome the liabilities. And since profits arguably drive the marketplace, a highly beneficial product would never enter the marketplace merely because of profit concerns. Passing the costs onto the consumer might cause consumers not to purchase the product and once again, profit concerns arise so the manufacturer decides not to produce.

States, the biotechnology industry experienced a similar problem.[190] According to the International Trade Administration, products liability law is a "severe" barrier for innovation in the biotechnology industry.[191] Many of the United States' major drug corporations are ceasing to produce newer and safer vaccines because of excessive liability costs associated with drug production, with insurance being the major cost plaguing the biotechnology companies.[192] Between 1980 and 1988, lawsuits for biotechnology products liability increased by 813%.[193] "In 1984 alone, $9.8 million of manufacturer's litigation costs were not reimbursed by insurance, and by that time, plaintiffs had requested over $3.5 billion in damages."[194] Damages drastically increased too—from 1975 to 1986, "the average jury verdict in product[s] liability cases had increased from $400,000 to over $1.8 million."[195] Consequently, between the years 2007 and 2010, the number of publically traded biotechnology companies located in the United States decreased by one-hundred, which reduced the market by 25%.[196] Even worse, projections indicate that more companies will continue to leave the marketplace.[197]

Vaccines and other important products produced by biotechnology companies have a high social utility because they prevent disease, lower healthcare costs, and generally advance humanity.[198] In contrast, biotechnology companies are concerned

190. *See* Philip M. Boffey, *Vaccine Liability Threatens Supplies*, N.Y. TIMES (June 26, 1984), *available at* http://www.nytimes.com/1984/06/26/science/vaccine-liability-threatens-supplies.html?pagewanted=all.
191. Stovsky, *supra* note 180, at 365.
192. *Id.* at 373 ("One of the foremost obstacles faced by firms attempting to market biotechnological products is the cost of insuring their products against product liability claims.").
193. *Id.*
194. Evan L. Rosenfeld, *The Strict Products Liability Crisis and Beyond: Is There Hope for an AIDS Vaccine?*, 313 JURIMETRICS J. 187, 196 (1991).
195. Stovsky, *supra* note 180, at 373.
196. Rob Waters, *Shrinking U.S. Biotechnology Sector Lost 25% of Companies in Past 3 Years*, BLOOMBERG.COM (Oct. 5, 2010, 6:22 P.M.), http://www.bloomberg.com/news/2010-10-05/shrinking-u-s-biotechnology-sector-lost-25-of-companies-in-past-3-years.html. The current economic instability is another major factor to consider.
197. *See* Stovsky, *supra* note 180, at 374
198. *See generally Understanding Vaccines What They Are How They Work*, U.S. DEPT. OF HEALTH AND HUMAN SERV. (Jan. 2008), *available at* http://www.niaid.nih.gov/topics/vaccines/documents/undvacc.pdf; Stovsky, *supra* note 180, at 376 ("The threat of enormous and unpredictable liability continues to weigh heavily in our decisions relating to the development of new products and to improvements to existing ones. This is particularly significant in pharmaceuticals and other high-technology health-care products. In cases involving these

with mitigating the unpredictability that strict and products liability presents, resulting in stifled innovation and thereby providing society with less benefits than otherwise would have resulted.[199]

D. *Social Utility of Autonomous Cars*

Likewise, autonomous cars can significantly reduce the number of car accidents, injuries, deaths, and costs related to cars accidents because 95% of car accidents in the United States are the result of human error.[200] To illustrate, over 40,000 people die each year as a result of car accidents in the United States.[201] Recent studies in Europe show:

> that applying brakes half a second earlier in a car traveling at 50 km/h can reduce the crash energy by 50 percent. But an analysis of German accidents showed that 39 percent of drivers didn't activate their brakes before the collision, and 40 percent didn't apply brakes effectively.[202]

On the other hand, autonomous cars have faster reaction times than humans.[203] Studies suggest that "81 percent of 'non-impaired'

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products jurors are left free to second-guess the weight of impartial scientific opinion and the Food and Drug Administration, to find manufacturers at fault, and to award multi-million-dollar verdicts. As a result, valuable products whose potential profitability is outweighed by the risk of enormous liability never see the light of day.").

199. Stovsky, *supra* note 180, at 376 ("The uncertain threat of strict liability strongly deters development of biotechnology products.").

200. Hannah Elliott, *Most Dangerous Times To Drive*, FORBES (Jan. 21, 2009, 4:00 PM), http://www.forbes.com/2009/01/21/car-accident-times-forbeslife-cx_he_0121driving.html ("'I think that people in some instances have a false sense of their own abilities and a false sense of their abilities to multitask,' [Rae Tyson, spokesman for the National Highway Traffic Safety Administration] says. "'Since most of those crashes are a result of human error, somebody's got to be making a lot of mistakes.'").

201. *Id*; *see also* David H. Freedman, *Impatient Futurist Are We Finally Ready for Self-Driving Cars?*, DISCOVER MAGAZINE (Apr. 2011), *available at* http://discovermagazine.com/2011/apr/10-future-tech-finally-ready-self-driving-cars ("The Centers for Disease Control and Prevention estimates that car crashes killed nearly 40,000 people and cost more than $70 billion in the United States last year.").

202. Forrest & Konca, *supra* note 18, at 30-31.

203. Markoff, *supra* note 49 ("Robot drivers react faster than humans, have 360-degree perception and do not get distracted, sleepy or intoxicated, the engineers argue."); *see also* Folsom, *supra* note 189 ("Manual driving requires space between vehicles for driver reaction time and brake application time in emergencies. In an autonomous system, there is no driver and thus cognition time is a few milliseconds."); Evan Ackerman, *CMU Develops Autonomous Cars Software That's Probably*

crashes could be avoided" due to autonomous cars' ability to communicate with each other over a special radio spectrum.[204] Moreover, in 2009, twenty percent of car accidents involved distracted drivers,[205] and 11,000 people died as a result of alcohol-impaired drivers.[206] However, unlike humans, it is not possible for autonomous cars to become intoxicated or distracted.[207] Therefore, alcohol-related deaths and distracted driver accidents would substantially decrease.

Furthermore, notwithstanding the increases in safety that autonomous cars would provide, commuting time and efficiency could be significantly improved. In 2005, the average person in the United States spent one hundred hours commuting to work in a car.[208] Engineers predict that autonomous cars would improve traffic congestion and road use by allowing cars to drive closer together and

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Safe, IEEE SPECTRUM (July 1, 2011), http://spectrum.ieee.org/automaton/robotics/artificial-intelligence/cmu-develops-autonomous-car-software-that-is-provably-safe ("It's one thing to ramble on (like we do) about how autonomous cars are way safer than human driven cars, but it's another thing to prove it. Like, mathematically. A research group at Carnegie Mellon has created a distributed control system for autonomous highway driving and then verified that it's safe. In other words, the software itself provably [sic] cannot cause an accident.").

204. Gross, *supra* note 16 ("'That's going to be our next major safety advance - on par with airbags or safety belts,' Belcher said. Belcher said studies suggest that as many as 81 percent of 'non-impaired' crashes could be avoided through vehicle-to-vehicle communication, which uses a dedicated part of the radio spectrum that's been set aside by the federal government.").

205. *Statistics and Facts About Distracted Driving*, DISTRACTION.GOV, http://www.distraction.gov/stats-and-facts/ (last visited Nov. 13, 2011, 8:51 PM).

206. MOTOR VEHICLE SAFETY, CDC, http://www.cdc.gov/motorvehiclesafety/ (last visited Nov. 13, 2011, 8:54 PM).

207. However, take note that another issue is hackers, which may have the capability to upload viruses that "intoxicate" or "distract" the software or hardware in an autonomous car. *See* Markoff, *supra* note 15 ("There will also be unpredictable technological risks, several participants said. For example, future autonomous vehicles will rely heavily on global positioning satellite data and other systems, which are vulnerable to jamming by malicious computer hackers.").

208. *See Americans Spend More Than 100 Hours Commuting to Work Each Year, Census Bureau Reports*, U.S. CENSUS BUREAU (Mar. 30, 2005) ("Americans spend more than 100 hours commuting to work each year, according to American Community Survey (ACS) data released today by the U.S. Census Bureau. This exceeds the two weeks of vacation time (80 hours) frequently taken by workers over the course of a year. For the nation as a whole, the average daily commute to work lasted about 24.3 minutes in 2003.").

communicate with each other.[209] As a result, not only would humans' overall time spent in cars decrease, but the time spent commuting in cars could be used for other tasks.[210] Even travel times will become more accurate because the cars could calculate the travel times with precision by communicating with other cars—making less people late for work—and further improving efficiency.[211]

Additionally, engineers also predict that autonomous cars will increase fuel economy and thereby save the United States billions of dollars.[212] Particularly, with current fuel prices projected to reach a record high of five dollars per gallon in the near future, fuel efficiency is of paramount importance.[213] According to the U.S. Department of Transportation, aggressive drivers' gas mileage is thirty-three percent higher than that of an average driver.[214] Autonomous cars, however, will effectively eliminate aggressive drivers, thereby decreasing carbon emissions and saving governments, corporations, and people billions of dollars.

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209. Markoff, *supra* note 49; *see also* Keith Barry, *Semi-Autonomous Road Train Trial Is a Success*, WIRED (Jan. 26, 2012, 6:30 AM), http://www.wired.com/autopia/2012/01/semi-autonomous-road-train-trial-is-a-success/ ("That allows the semi-autonomous vehicles in the train to follow together very closely, reducing congestion and decreasing energy use by up to 20 percent. Indeed, in the trail shown above, cars were a mere 20 feet from each other and travelled at speeds up to 56 mph, all while the folks in the driver's seats checked out their iPads."); *see also* Gross, *supra* note 16 (explaining how autonomous cars will communicate with each other).

210. The 100 hours only includes time commuting to work and does not include the total time spent in cars. *Cf. Americans spend more energy watching TV than on exercise*, UNIV. OF CAL. (Mar. 10, 2004), http://www.universityofcalifornia.edu/news/article/6189 ("The average daily duration for driving a car was 101 minutes . . . ."). Hence, the time currently wasted driving could produce substantial economic benefits.

211. Forrest & Konca , *supra* note 18, at 37 ("With the time waited on roads reduced, the ability to improve the overall efficiency is realized."); driver stress would also decrease substantially.

212. Markoff, *supra* note 49; *see also* FORREST & KONCA , *supra* note 18, at 38 ("[I]n 2004 people in the USA spent 424 billion dollars for fueling their vehicles.").

213. *See* Clifford Krauss, *Tensions Raise Spector of Gas at $5 a Gallon*, N.Y. TIMES, Feb. 29, 2012, at A1. ("With no clear end to tensions with Iran and Syria and rising demand from countries like China, gas prices are already at record highs for the winter months—averaging $4.32 in California and $3.73 a gallon nationally on Wednesday, according to AAA's Daily Fuel Gauge Report. As summer approaches, demand for gasoline rises, typically pushing prices up around 20 cents a gallon.").

214. Forrest & Konca , *supra* note 18, at 38.

Therefore, if autonomous cars enter the market, it is apparent that millions of lives and billions of dollars will be saved.[215] The social utility of autonomous cars is undoubtedly significant.[216] Yet, if the current liability framework is applied to autonomous cars, the computer programmers and manufacturers of autonomous cars and technology may make similar decisions that members of the biotechnology industry made due to the threat of uncertain liability. While products and strict liability will not act as an impregnable barrier to entry, it will probably hinder the introduction of autonomous cars into the marketplace.[217] And while autonomous cars will eliminate many tort claims against drivers due to their increased safety and efficiency,[218] the number of products and strict liability claims against the manufacturers of autonomous cars likely will increase upon introducing autonomous cars into the marketplace.[219]

215. *Id.* at 30-40; *see also* Cowen, *supra* note 18.

216. Cowen, *supra* note 18.

217. *See* NIDHI KALRA, ET AL., LIABILITY AND REGULATION OF AUTONOMOUS VEHICLE TECHNOLOGIES 34 (2009), *available at* http://www.dot.ca.gov/research/researchreports/reports/2009/prr-200928_liability_reg_&_auto_vehicle_final_report_2009.pdf ("However, manufacturers' well-founded liability concerns may slow the introduction of even socially beneficial technologies."); *see also* Cowen, *supra* note 18 ("About 40,000 Americans die each year in car accidents. Would driverless cars reduce this toll? We'll need further tests and development to know for sure. But the way things stand now, we may never get the chance to find out. Consider this thought experiment. Assume that driverless cars could certainly reduce deaths by avoiding accidents caused by people who drive while intoxicated or who simply make stupid driving decisions, like driving on the wrong side of the road. Add in the likelihood that even after they are perfected and well inspected, driverless cars would lead to special problems, perhaps if the computers don't respond properly to some unusual situations. To continue this experiment, imagine that the cars would save many lives over all, but lead to some bad accidents when a car malfunctions. The evening news might show a 'Terminator' car spinning out of control and killing a child. There could be demands to shut down the cars until just about every problem is solved. The lives saved by the cars would not be as visible as the lives lost, and therefore the law might thwart or delay what could be a very beneficial innovation.").

218. *See* KALRA ET AL., *supra* note 217, at 34 ("[T]he decrease in the number of crashes and the associated lower insurance costs that these technologies are expected to bring about will encourage the adoption of this technology by drivers and automobile-insurance companies.").

219. *See id.* ("[M]anufacturer liability is expected to increase, and this may lead to inefficient delays in the adoption of these technologies. Manufacturers may be held responsible under several theories of liability . . . .").

E. *Why Will Autonomous Car and Technology Manufacturers' Liability Increase at the Outset?*

When a new technology emerges, there is usually an increase in general negligence claims and liability.[220] For instance, a class action was already filed against Honda in 2008 claiming it:

> misrepresented the characteristics of the Collision Mitigation Braking System of the Acura RL vehicle. Plaintiffs argue[ed] that Honda knew, but omitted the following information from its pre-purchase marketing materials about the RL with the Collision Mitigating Breaking System ("CMBS"): (1) the three stages of the CMBS System overlap; (2) the CMBS will not warn drivers in time to avoid an accident; and (3) the CMBS shuts off in bad weather.[221]

On appeal, the Ninth Circuit vacated the plaintiff's renewed motion for class certification and remanded it for further proceedings.[222] The Honda case, nevertheless, is merely a glimpse of the increase in claims that automobile manufacturers will see in the future if autonomous cars are introduced into the marketplace.[223] T he

220. Mark F. Grady, *Why are People Negligent? Technology, Nondurable Precautions, and Medical Malpractice Explosion*, 82 NW. U. L. REV. 293 (1988) ("Negligence law is fundamentally a creature of technology; really, it is the common law's response to technology. Advances in technology can easily cause corresponding increases in the number of negligence claims. Revolutions in an industry's technology will often impose tremendous new loads on the negligence system.").

221. Mazza v. Am. Honda Motor Co., 254 F.R.D. 610, 615 (C.D. Cal. 2008), *vacated sub nom.* Mazza v. Am. Honda Motor Co., Inc., 666 F.3d 581 (9th Cir. 2012); *see also Collision Mitigation Braking System*, ACURA.COM (last visited Mar. 7, 2012, 9:26 pm), http://owners.acura.com/Model/Features.aspx?feat=Collision_Mitigation_Vehicle&modelid=YB1H6CKNW ("The ZDX Collision Mitigation Braking System™ (CMBS™) helps reduce the likelihood of rear-ending the vehicle ahead by alerting the driver before a collision occurs. Powered by a radar transmitter mounted behind the grille, a signal is constantly transmitted and the return signal is evaluated, determining the distance and closing speed of vehicles that lie directly ahead. When a collision is considered unavoidable, the CMBS system takes steps to minimize the severity of the collision. CMBS works automatically without any driver input, but can be shut off if the driver prefers.").

222. *Mazza*, 666 F.3d. at 597. Although Honda was not required to compensate anyone at this point in the litigation, Honda has probably already paid substantial legal fees defending the case to this point. It does not matter whether or not the car manufacturers win or lose cases. The fact that cases are being filed is sufficient evidence to establish that these manufacturers are paying substantial amounts of money to defend these cases.

223. *See generally* Grady, *supra* note 222, at 293.

autonomous car owners will inevitably blame their cars for crashes.[224] With new autonomous technologies, there will generally be a shift in liability from the human owner to the manufacturer of the defective product.[225] Particularly, with autonomous cars, many torts caused by human error—such as negligence claims between drivers or drunk driving accidents—will dramatically decrease.[226] Yet, with the new autonomous technology, many new claims will arise.[227] For instance, faulty technology or errors in the computer software may cause many accidents. In this case, the manufacturer or developer of the defective technology would be held liable based on the policy rationale of products and strict liability.[228]

Take for example, current robotic cleaning technology.[229] These robots merely vacuum or wash floors, vacuum pool floors, or clean

224. *Safer at any speed?*, THE ECONOMIST, Mar. 3, 2012, at 77 ("Another headache will be lawsuits from motorists blaming their car for crashes.").

225. KALRA ET AL., *supra* note 217, at 34 ("We anticipate that current liability laws may lead to inefficient delays in manufacturers introducing autonomous vehicle technologies. The gradual shift in responsibility for automobile operation from the driver to the vehicle will lead to a similar shift in liability for crashes from the driver to the manufacturer.").

226. Markoff, *supra* note 15 ("As Google has demonstrated, computerized systems that replace human drivers are now largely workable and could greatly limit human error, which causes most of the 33,000 deaths and 1.2 million injuries that now occur each year on the nation's roads."); *see also* Jason Koebler, *New Traffic Management System May Clear the Way For Driver-less Cars*, U.S. NEWS AND WORLD REPORT (Feb. 17, 2012), http://www.usnews.com/news/articles/2012/02/17/new-traffic-management-system-may-clear-the-way-for-driver-less-cars ("Without sacrificing safety at all, we can get a lot more efficiency and less traffic delay, he says. Watching other cars whiz by at full speed just feet from your vehicle might not sound appetizing, but Stone says once people clear a 'mental hurdle,' it'll become the norm. Can we do better than human drivers? That's not really a high bar to clear ... I believe they will be significantly safer than human drivers. They won't drive drunk, suffer from road rage, or text while driving.") (quoting Peter Stone, a computer scientist at the Univ. of Texas at Austin).

227. *See, e.g.*, Steve Lohr, *Product Liability Laws Are New Threat to Microsoft*, N.Y. TIMES, Oct. 6, 2003, at C2 *available at* http://www.nytimes.com/2003/10/06/business/product-liability-lawsuits-are-new-threat-to-microsoft.html?pagewanted=all&src=pm (showing that when Microsoft came out with its new operating system, products liability suits ensued).

228. Restatement (Second) of Torts § 402A cmt. c (1965).

229. *iRobot: Cleaning Robots*, IROBOT.COM (last visited Mar. 8, 2012, 12:25 pm), http://store.irobot.com/shop/index.jsp?categoryId=2804605 ("Our home robots are revolutionizing the way people clean, inside and out. More than 6 million home robots have been sold worldwide, with the

gutters.[230] These robots are simply the combination of cleaning devices with wheels, primitive AI, and sensors.[231] Until these robots existed, most people either cleaned their own homes or hired human maids. In the case that a human maid caused damage or injury, the person who incurred the damage would sue the maid or the maid's employer. If a robotic vacuum caused damage, the person who incurred the damage would sue the robot's manufacturer and possibly others involved in its production. Whereas humans and corporations composed of human workers were liable in the past, manufacturers of the robotic technology are liable now, hence the shift in liability.

Analogizing this to autonomous cars, when a human crashes her car into someone because she was texting and not paying attention, the injured person can sue the human driver because the texting driver's negligence proximately caused the damage incurred. Yet, if the human variable was completely removed and the car's autonomous technology caused the crash, the injured person would sue the developer or manufacturer of the technology on a products or strict liability theory. As a result, autonomous car and technology manufacturers will be responsible for more claims under products and strict liability.

As with other developing technologies, there will be technical issues that need to be addressed.[232] The technology will inevitably cause accidents. Based on how courts currently analyze analogous autonomous technologies, it is reasonable to anticipate that courts will apply products and strict liability to the manufacturers of autonomous cars when the car is the sole cause of damage.[233] Accordingly, manufacturers of autonomous technology and cars will incur more liability than they are currently accustomed. As a result, the liability and costs incurred require some form of mitigation.

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award-winning iRobot Roomba® Vacuum Cleaning Robot leading the charge.").

230. *Id.* (showing for sale the iRobot Roomba vacuum cleaning robots, the iRobot Scooba floor washing robots, the iRobot pool cleaning robots, and the iRobot Looj gutter cleaning robot).

231. *iRobot: Get to Know Your Robot*, IROBOT.COM (last visited Mar. 8, 2012, 12:30 pm), http://store.irobot.com/shop/index.jsp?categoryId=2804605 (explaining the technology of iRobot cleaning robots).

232. *See, e.g.*, *Toyota Recall Information – 2009-2011 Recall Notices*, TOYOTA (last visited Mar. 17, 2012, 10:17 pm), http://www.toyota.com/recall/ (providing consumers of Toyota vehicles with the most updated information regarding vehicle recalls).

233. *See supra*, Section III.

IV. PROPOSAL: APPLYING THE PRICE-ANDERSON ACT TO AUTONOMOUS CARS

The Restatement Second of Torts Section § 402A states that although public policy places the burden on manufacturers and producers to compensate those harmed by their products, this cost can be mitigated by liability insurance.[234] Given the potentially high social utility of autonomous cars,[235] and the theoretical increase in autonomous car manufacturers' liability,[236] the current liability framework requires modification in order to establish a two-tiered insurance program similar to the nuclear energy industry's Price-Anderson Act. The purpose of the two-tiered insurance structure is to eliminate uncertainties regarding manufacturer liability. In addition, the insurance structure is also designed to incentivize the autonomous car manufacturers to engage in the production of autonomous cars and technology. The new insurance structure, moreover, is constructed to spur autonomous car manufacturers to produce safe autonomous vehicles. Nevada has already set forth some preliminary specifications for "autonomous technology certification facilit[ies]."[237] The certification facilities' purpose is to determine the

234. Restatement (Second) of Torts § 402A cmt. c (1965) ("On whatever theory, the justification for the strict liability has been said to be that the seller, by marketing his product for use and consumption, has undertaken and assumed a special responsibility toward any member of the consuming public who may be injured by it; that the public has the right to and does expect, in the case of products which it needs and for which it is forced to rely upon the seller, that reputable sellers will stand behind their goods; that public policy demands that the burden of accidental injuries caused by products intended for consumption be placed upon those who market them, and be treated as a cost of production against which liability insurance can be obtained; and that the consumer of such products is entitled to the maximum of protection at the hands of someone, and the proper persons to afford it are those who market the products.").

235. Markoff, supra note 15 ("As Google has demonstrated, computerized systems that replace human drivers are now largely workable and could greatly limit human error, which causes most of the 33,000 deaths and 1.2 million injuries that now occur each year on the nation's roads. Such vehicles also hold the potential for greater fuel efficiency and lower emissions—and, more broadly, for restoring the United States' primacy in the global automobile industry."); see supra, Section III.

236. Markoff, supra note 15 ("Potential liabilities will be huge for the designers and manufacturers of autonomous vehicles, said Gary E. Marchant, director of the Center for Law, Science and Innovation at the Arizona State University [L]aw [S]chool."); see supra, Section III.E.

237. Reg. Relating to Autonomous Vehicles, supra note 9, at 6 ("Before an autonomous vehicle may be registered in this State, the owner of the autonomous vehicle must submit to the Department, in addition to any other requirement set forth in chapter 482 of NRS for registering a vehicle,

autonomous car's compliance with Nevada's autonomous car regulations.[238]

In the proposed framework, the vehicle safety inspection facilities would not only certify autonomous car owners, but would also proactively diagnose possible pitfalls in the hardware and software. To determine which party initially bears full liability, each state should establish a similar vehicle safety inspection program to ensure that all autonomous car hardware and software is functioning within agreed upon parameters set forth by both the industry and the government.

A. *Vehicle Safety Inspections*

In the United States, many state legislatures have promulgated statutes that require current vehicle owners to have their vehicles inspected for mechanical soundness.[239] If the vehicle owners do not obtain a satisfactory result, or fail to have their vehicle inspected, they cannot lawfully operate their vehicle in that state.[240] In many cases, these safety inspections are very rigorous. For example, in Pennsylvania, all passenger cars and light trucks driven on highways require an annual inspection.[241] Certified mechanics inspect a plethora of systems, including each car's suspension, steering, and braking

a copy of the certificate of compliance issued by the manufacturer of the vehicle or by a licensed autonomous technology certification facility pursuant to section 16 of this regulation.").

238. See id. (setting forth the specifications and requirements of compliance with the facilities).

239. Motor Vehicle Inspection Div. and the Statistical Analysis Ctr, Nationwide and Missouri Motor Vehicle Safety Inspection Program Fatal Crash Analysis 2005-2007 11 (2008), available at http://www.mshp.dps.missouri.gov/MSHPWeb/Publications/OtherPublications/documents/fatalCrash2005_2007.pdf (showing that as of 2007, these states have required motor vehicle inspection programs: Delaware, Hawaii, Louisiana, Maine, Massachusetts, Mississippi, Missouri, New Hampshire, New Jersey, New York, North Carolina, Pennsylvania, Rhode Island, Texas, Utah, Vermont, Virginia, and West Virginia).

240. See e.g., Motor Vehicle Information for New Residents, Pa. Dep't. of Transp., http://www.dmv.state.pa.us/new_residents/motor_vehicle.shtml (last visited Mar. 19, 2012, 11:34 AM) ("A vehicle newly registered in Pennsylvania must be safety inspected within ten (10) days of the registration date. Inspections are performed at official inspection stations (usually a repair garage or a service station with a repair shop). Equipment checks include: lights, brakes, horn, tires, safety belts, exhaust system, mirrors, tag mounting, suspension, turn signals, steering, glazing, wipers, and other major parts of your vehicle.").

241. 67 Pa. Code § 175.6 (1998).) available at, http://www.pacode.com/secure/data/067/chapter175/067_0175.pdf.).

systems.[242] In addition, the Pennsylvania state legislature has provided detailed procedures for the mechanics to follow when executing these inspections.[243] If someone fails the inspection, he or she does not receive an inspection sticker, which is required for vehicle registration in Pennsylvania.[244] The Pennsylvania Department of Transportation contracted a private company to analyze the effectiveness of its vehicle safety program and concluded that the "results of the research clearly demonstrate that the Vehicle Safety Inspection program in Pennsylvania is effective and saves lives."[245]

Likewise, Missouri has an established vehicle safety inspection program, and it conducted a study that analyzed whether the vehicle inspection programs had an impact on "reducing vehicle defects as a causation factor in the worst types of traffic crashes."[246] The study concluded that while Missouri's program is more effective than all of the states with and without safety inspection programs aggregated, states with safety inspection programs had more cars with defects that were involved in fatal crashes than states without programs.[247] Furthermore, many critics disagree with the overall effectiveness of the vehicle safety inspections and deem the programs as "expendable."[248] In 2009, the District of Columbia decided to cut its vehicle safety inspection program to save about $400,000 annually.[249]

242. Id. at §§ 175.6-175.78 (The mechanics also inspect the tires and wheels, lighting and electrical systems, glazing, mirrors, windshield defrosters, windshield washers, windshield wipers, fuel systems, speedometers, odometers, exhaust systems, horns and warning devices, body, and chassis.).

243. Id. at § 175.80.

244. Motor Vehicle Information for New Residents, supra note 239.

245. Nicholas J. Vlahos et al., Pennsylvania's Vehicle Safety Inspection Program Effectiveness Study (070609) ES-1, (2009), available at http://www.dmv.state.pa.us/pdotforms/inspections/Inspection%20Program%20Effectiveness%20Study.pdf.

246. Motor Vehicle Inspection Div. and the Statistical Analysis Ctr., Nationwide and Missouri Motor Vehicle Safety Inspection Program Fatal Crash Analysis 2005-2007 3 (2008), available at http://www.mshp.dps.missouri.gov/MSHPWeb/Publications/OtherPublications/documents/fatalCrash2005_2007.pdf ("The analysis was limited to an examination of vehicles involved in traffic crashes resulting in the death of one or more persons."); (The study defined vehicle defects as including defects with "tires, brakes, steering system, exhaust system, headlights, signal lights, horn, mirrors, wipers, and wheels.").

247. Id.

248. Sharon Silke Carty, D.C. junks car safety inspections: Will others, too?, USAToday.com (Dec. 10, 2009, 10:35 AM), http://www.usatoday.com/money/autos/2009-12-10-inspections10_CV_N.htm.

249. Id. ("Pennsylvania's safety-inspection program—11 million inspections a year at 17,000 private garages—costs about $300 million a year. Just $1.5

Marc Poitras, a professor of economics at the University of Dayton does not believe that the programs are cost effective, and he stands behind the "Peltzman Effect."[250] The Peltzman Effect theorizes that vehicle safety programs provide drivers with a false sense of security, resulting in less prudent driving.[251] Nevertheless, the purpose of vehicle safety inspections is not aimed at the drivers—but rather "to identify and remove unsafe vehicles from the road".[252] Even if the Peltzman Effect holds true for the current vehicle safety programs, the argument is moot regarding autonomous cars since they are operated by software and hardware, not humans with a false sense of security.

With respect to autonomous cars and the proposed framework, as long as the owners of autonomous cars bring their cars in for safety inspections, the liability will shift to the manufacturer.[253] This shift, however, is the crux of the autonomous car liability controversy. Products and strict liability will undoubtedly be the leading theory of recovery in the case that an autonomous vehicle's technology is the proximate cause of harm or injury.[254] Other high-risk, high-utility industries have faced a similar problem.[255] To ensure these industries enter the marketplace swiftly—or at all—the federal government sometimes intervenes.[256]

million is paid by the state. The rest is borne by vehicle owners, who pay $16 or $23 for the safety inspections, depending on the type and age of their vehicles. Emissions testing, where required, is a separate fee.").

250. See Paul G. Specht, The Peltzman Effect: Do Safety Regulations Increase Unsafe Behavior?, 4 The J. of SH & E Res. 3, 2 (2007), available at http://www.asse.org/academicsjournal/archive/vol4no3/docs/fall07-feature02.pdf.

251. Carty, supra note 248 (describing the Peltzman Effect as "a theory that holds that vehicle-safety efforts actually can negate their own impact.").

252. VLAHOS, *supra* note 245.

253. There will be a time frame in which an owner must bring his or her car in for a safety inspection. So if the government requires owners of autonomous cars to have their cars inspected three times a year, there are three time frames. As long as the owner brings his or her car in as required, liability is shifted to the manufacturer during that time frame until that time frame is over, and the liability shifts back to the owner until they bring it in for another inspection. Not only does this incentivize the owners to bring their cars in, but also increases the likelihood that technical errors are found since this is a proactive program. Note, that regardless of the shift in liability, the owner of the autonomous car will remain liable for any damages caused by his or her own negligence.

254. *See supra* Section III.

255. *See infra*, Section IV.B.

256. *Id.*

B. *Nuclear Energy & the Price-Anderson Act: High-Risk & High-Utility*

Currently, twenty percent of the United States' total energy is generated by nuclear power.[257] However, in 1956 the private nuclear power industry was nonexistent due to concerns about the damage that would occur in the event of a nuclear power plant accident.[258] Whereas most industries utilize liability insurance, in the 1950s, insurance companies had neither the experience nor the financial resources to insure a nuclear power plant.[259] In 1957, Congress passed the Price-Anderson Act, which "added indemnity provisions to the Atomic Energy Act of 1954."[260] Congress's goal was to create a liability fund with specific procedures in order to adequately compensate those injured as a result of a nuclear accident.[261]

257. *What is the status of the U.S. nuclear industry?*, U.S. ENERGY INFO. ADMIN. (Apr. 22, 2011), http://www.eia.gov/energy_in_brief/nuclear_industry.cfm ("There are currently 104 operable commercial nuclear reactors at 65 nuclear power plants. Since 1990, the share of the Nation's total electricity supply provided by nuclear power generation has averaged about 20%, with increases in nuclear generation that have roughly tracked the growth in total electricity output.").

258. Green, *supra* note 22, at 482 ("Specific figures finally emerged with the release in 1957 of a study prepared for the AEC by its Brookhaven National Laboratory. The Brookhaven Report concluded that in the event of a serious accident (in a nuclear power plant of the general type then contemplated at a typical location) resulting in release of all accumulated fission products as many as 3,400 people might be killed; as many as 43,000 people might be injured; and as much as 7 billion dollars in property damage might result, largely from long-term land contamination.").

259. *Id.* at 483 ("First, the insurance companies had no experience with the risks of nuclear reactors. Second, the amount of the potential liability was many orders of magnitude beyond the capacity of the insurance industry.").

260. 42 U.S.C.A. § 2210 (2005); *see also* Green, *supra* note 22, at 486-87 ("This time it was passed by the House by voice vote after debate and by the Senate without debate."); *see also* In re Three Mile Island Litig., 87 F.R.D. 433, 436 (M.D. Pa. 1980) ("The Atomic Energy Act of 1954 was passed to establish a legal framework for the development, use and control of atomic energy. In 1957 the Price-Anderson Act added indemnity provisions to the Atomic Energy Act.").

261. *Three Mile Island*, 87 F.R.D. at 436 ("The Atomic Energy Act of 1954 was passed to establish a legal framework for the development, use and control of atomic energy. In 1957 the Price-Anderson Act added indemnity provisions to the Atomic Energy Act. It was the goal of Congress to establish a liability fund, with procedures governing claims against the fund, to facilitate the rapid and adequate financial compensation of individuals if there ever were a nuclear accident.").

Substantively, each state's liability laws govern the theories of recovery.[262]

Under the Act, each nuclear reactor is required to obtain a "first tier" private insurance policy, valued at $375 million.[263] In the event of a nuclear accident costing in excess of $375 million, the Act's "second tier" liability fund is used to cover the surfeit of expenses.[264] The private company operating the nuclear reactor is required to pay its "prorated share of the excess up to $111.9 million," which comes from the second tier or pool of funds.[265] Currently, there are 104 nuclear reactors in the United Sates with over $11.6 billion in the secondary pool of funds.[266] Annually, each nuclear reactor must "contribute up to $95.8 million" to the secondary pool.[267] The Three Mile Island accident is an example of how the Act operates.[268]

262. JACK K. LEVIN ET AL., 27A AM. JUR. 2D ENERGY AND POWER SOURCES § 408 (2d ed. 2012) ("The substantive rules for decision in a public liability action will be derived from the law of the state in which the nuclear incident involved occurred, unless such law is inconsistent with the provisions of the federal statute establishing the cause of action.").

263. FACT SHEET ON NUCLEAR INS., *supra* note 25.

264. *Id.*

265. *Id.*

266. *Id.*

267. *The Price-Anderson Act*, AM. NUCLEAR SOC'Y (Nov. 2005), *available at* http://www.ans.org/pi/ps/docs/ps54-bi.pdf ("Power reactor licensees are required to have the maximum level of primary insurance available from private sources (currently $300 million) [sic] and to contribute up to $95.8 million per unit to a secondary insurance pool, payable in annual installments of $15 million or less, and subject to adjustments for inflation at five-year intervals.") [hereinafter Am. Nuclear Soc'y].

268. FACT SHEET ON NUCLEAR INS., *supra* note 25 ("When the accident at Three Mile Island Nuclear Power Plant in Middletown, Pa., occurred in 1979, the Price-Anderson Act provided liability insurance to the public. Coverage was available to those in need by the time Pennsylvania's governor recommended the evacuation of pregnant women and families with young children who lived near the plant. At the time of the accident, private insurers had $140 million of coverage available in the first tier pools. Insurance adjusters advanced money to evacuated families in order to cover their living expenses, only requesting that unused funds be returned; recipients responded by sending back several thousand dollars. The insurance pools also reimbursed over 600 individuals and families for wages lost as a result of the accident. In addition to the immediate concerns, the insurance pools were later used to settle a class-action suit for economic loss filed on behalf of residents who lived near Three Mile Island. Because the Price-Anderson Act allowed for a certain amount of money to be spent on each accident, it covered court fees as well. The last of the litigation surrounding the accident was resolved in 2003. To date, the insurance pools have paid approximately $71 million in claims and litigation costs associated with the Three Mile Island accident.").

Overall, the Three Mile Island accident cost over $70 million.[269] However, since the first tier policy covered up to $375 million, there was no need to delve into the second tier.[270]

One of the major benefits of the Act was that it created an incentive for the private insurance industry to establish a financially sound "means by which nuclear power plant operators could meet their financial protection responsibilities."[271] The American Nuclear Insurers draft all nuclear insurance policies, which are drafted with the intention to spread the risk over many insurance companies throughout the world through pooling.[272] Since 1962, the insurance companies have only paid out $151 million in claims.[273]

C. *Analogizing the Price-Anderson Act to Autonomous Car Liability*

Nuclear energy currently provides society with substantial benefits, as will autonomous cars in the future.[274] Still, both nuclear energy and autonomous cars are high-risk—particularly at the outset—because the technology is new and unpredictable. The Price-Anderson Act was a well-suited solution to the private nuclear energy conundrum.[275] The Act did not place any financial burden on either the government or the public, and it removed a barrier to entry by placing an insurance ceiling on the total amount of damages that the private sector may need to pay in the event of a nuclear accident.[276]

269. Am. Nuclear Soc'y, *supra* note 267, at 3.

270. *Id.*

271. *Id.* at 2.

272. *Id.* ("The American Nuclear Insurers (ANI), which currently writes all nuclear liability policies, retains about one third of the liability exposure under each policy and cedes the remaining two thirds to insurers around the world. This approach allows ANI to marshal the resources of the worldwide insurance community and spread the uncertainties of the risk over a large financial base. The Act has enabled insurers to provide stable, high quality coverage for nuclear risks.").

273. *Id.* at 3 ("In the 43 years of Price-Anderson protection, the nuclear insurance pools have paid a total of $151 million for claims. The Department of Energy has paid about $65 million during this same period.").

274. *See supra*, Section III.

275. American Nuclear Society, *supra* note 267, at 3; *see also Insurance: Price-Anderson Act Provides Effective Liability Insurance at No Cost to the Public*, NUCLEAR ENERGY INST. (Sept. 2011), http://www.nei.org/resourcesandstats/documentlibrary/safetyandsecurity/factsheet/priceandersonact ("The act has proven so successful that Congress has used it as a model for legislation to protect the public against potential losses or harm from other hazards.").

276. Am. Nuclear Soc'y, *supra* note 267, at 3 ("The Price-Anderson Act is a consumer- [sic] and public-oriented legislation. It provides a substantial amount of insurance protection paid by the commercial sector at no cost

Obtaining liability insurance, furthermore, is not an unforeseeable cost—it is merely one of the normal costs of engaging in business.[277] The annual payments are justified by the profits reaped and the risk taken upon engaging in business, especially high-risk endeavors. Even in the unlikely case that the ceiling is surpassed, Congress is required to determine a solution.[278] But more importantly, private nuclear reactors are not the only industry that the government has provided a special insurance framework:[279]

It should be noted that the federal government provides similar insurance mechanisms for other types of disasters, such as floods; agricultural disasters; banks and savings and loan company failures; home mortgages; and maritime accidents. Liability limits also exist for oil spills; bankruptcy; worker's compensation; and medical malpractice.[280]

Establishing a similar insurance framework for autonomous car manufacturers would presumably produce similar results. By instituting a similar insurance framework, autonomous car and technology manufacturers will not have to worry about the risk of liability affecting their profits because there will be two tiers of insurance and a ceiling on damages.[281] Under the program, each autonomous car or technology manufacturer will have to annually pay its *pro rata* share into the second-tier, just like the nuclear industry does with the Price-Anderson Act.[282] Each manufacturer's share is dependent on what the manufacturer produces, its predicted revenue, and the amount of risk it is predicted to incur in the future.[283] In order to be eligible, the manufacturer needs to be registered with the

to the public or the government. The Act has removed the deterrent to private sector participation in nuclear activities presented by the threat of potential liability claims following a large accident.").

277. *See* KEETON ET AL., *supra* note 140, at 584-88 (explaining liability insurance and its impact on tort law); *see also* S.S. Kresge Co. v. Port of Longview, 18 Wash. App. 805, 812 (Wash. Ct. App. 1977) ("he can make the expense of liability insurance a cost of doing business . . . .") (*citing* Pappas v. Carson, 50 Cal. App. 3d 261, 269 (Cal. Ct. App. 1975)).

278. *See* FACT SHEET ON NUCLEAR INS., *supra* note 26.

279. Am. Nuclear Soc'y, *supra* note 267, at 3.

280. *Id.*

281. *See* LeBeau, *supra* note 15.

282. Am. Nuclear Soc'y, *supra* note 267.

283. Since some of those involved may be large car manufacturers, such as General Motors, while others may be small hardware or software firms, multiple variables will determine each manufacturer's *pro rata* share. If a company merely creates radars and nothing else, they should pay less than GM, who will probably manufacturer and profit much more.

government and meet certain qualifications set forth by both industry and the government. While this framework based on the nuclear industry will likely have the same positive results for the autonomous car industry, there is are still concerns: what if the autonomous car industry depletes the second tier of liability insurance?[284]

In the case that the first and second tiers of liability insurance are depleted, just as the Price-Anderson Act requires for the nuclear industry, Congress should determine a solution.[285] Asking Congress to act is merely an ultimate failsafe should the second tier be depleted, particularly considering the cantankerous nature of the legislative process and Congress. With "just about every traditional automaker . . . developing its own self-driving model,"[286] the second tier should have no problem establishing a substantial fund. The idea is that the mere existence of such an insurance program provides manufacturers of autonomous cars and technologies with a sense of security because, under this program, they will not suffer unsustainable losses.[287] But why do manufacturers of autonomous cars deserve special treatment?

Autonomous cars' social utility will be significant, and their creators merit special treatment.[288] These cars will save millions of lives and billions of dollars once they enter the marketplace.[289] Similarly, nuclear power is also beneficial to society.[290] For instance, nuclear power is carbon free—it emits no greenhouse gases.[291]

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284. *See* Am. Nuclear Soc'y, *supra* note 267.

285. *Id.*

286. Tom Vanderbilt, *Let the Robot Drive, The Autonomous Car of the Future Is Here*, WIRED (Jan 20, 2012), *available at* http://www.wired.com/magazine/2012/01/ff_autonomouscars/all/1 ("Google isn't the only company with driverless cars on the road. Indeed, just about every traditional automaker is developing its own self-driving model, peppering Silicon Valley with new R&D labs to work on the challenge.").

287. *See* LeBeau, *supra* note 15.

288. *See supra*, Section III.

289. *See supra*, Section III.

290. *See* Michael Totty, *The Case For and Against Nuclear Power*, WALL. ST. J., Jun. 30, 2008, at R3 *available at* http://online.wsj.com/article/SB121432182593500119.html (exploring the pros and cons of nuclear power).

291. *The Future of Nuclear Power*, MIT (July 23, 2003), http://web.mit.edu/nuclearpower/ ("'Fossil fuel-based electricity is projected to account for more than 40% of global greenhouse gas emissions by 2020,' said Deutch. 'In the U.S. 90% of the carbon emissions from electricity generation come from coal-fired generation, even though this accounts for only 52% of the electricity produced. Taking nuclear power off the table as a viable alternative will prevent

"Proponents of nuclear power say it is the only available method of producing large amounts of energy quickly enough to make a difference in the fate of the atmosphere."[292] Nuclear power, though, does have its drawbacks.[293] For instance, a nuclear reactor meltdown can cause substantial harm.[294] When weighing the social utility of nuclear power plants against the potential harm it can cause, the picture is not clear how beneficial nuclear power really is to society. The recent accident at the Fukushima Nuclear Power Plant in Japan in March 2011 caused damage that is predicated to cost upwards of $14 billion.[295] Nearly 170,000 people were displaced due to a "'major release of radioactive material . . .' causing 'health and environmental effects requiring implementation of planned and extended countermeasures.'"[296] Yet, in the United States, nuclear power is treated differently than other industries in terms of liability.[297] Conversely, when weighing autonomous cars' social utility against the harm they may cause, the benefits clearly outweigh the harm.

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the global community from achieving long-term gains in the control of carbon dioxide emissions.'"). *See also MIT Releases Interdisciplinary Study on the "Future of Nuclear Energy,"* MIT (July 29, 2003) (emphasis in original), *available at* http://web.mit.edu/nuclearpower/ ("But the prospects for nuclear energy as an option are limited, the report finds, by four unresolved problems: *high relative costs; perceived adverse safety, environmental, and health effects; potential security risks stemming from proliferation; and unresolved challenges in long-term management of nuclear wastes.*").

292. *Nuclear Energy*, N.Y. TIMES, http://topics.nytimes.com/top/news/business/energy-environment/atomic-energy/index.html?scp=1-spot&sq=nuclear%20power&st=cse (last visited Sept. 14, 2012).

293. *See id.* (providing an overview of the 2011 Japanese nuclear reactor accident and the general drawbacks of using nuclear energy as a power source).

294. *See id.* (providing an overview of the Three Mile Island and Chernobyl accidents).

295. Jacob Adelman, *Fukushima Cleanup Bill $14B Over 30 Years*, BLOOMBERG (Nov. 3, 2011), http://www.bloomberg.com/news/2011-11-04/fukushima-cleanup-bill-14b-over-30-years-ministry.html ("Contaminated material from Japan's wrecked Fukushima nuclear plant will be collected over 30 years and stored at a secure site at a cost of 1.1 trillion yen ($14 billion), according to the country's environment ministry.").

296. Catherine Butler et al., *Nuclear Power After Japan: The Social Dimensions*, ENVIRONMENT MAGAZINE, http://www.environmentmagazine.org/Archives/Back%20Issues/2011/November-December%202011/Nuclear-full.html (Last visited Mar. 10, 2012, 9:40 pm).

297. *See supra*, Section IV.A.

Although autonomous cars can cause damage, the worst-case scenario is by no means close to the nuclear power industry's worst-case scenario. Even if you aggregate all of the potential harm that autonomous cars might cause over many years, the autonomous cars still provide enough benefits to outweigh the aggregate. Nuclear power plants, though, may not. There is insufficient evidence to show nuclear reactors provide society with substantial benefits in comparison to the drawbacks.[298] Thus, if nuclear power plants provide society with less utility than autonomous cars will, yet still receive special protections, autonomous cars should be granted at least the same privileges that the nuclear power industry enjoys. All the same, regardless of autonomous cars' social utility, why do manufacturers of autonomous cars and technology need special treatment when they can merely pass the costs on to the consumer, just as other industries?

First, consumers may not be willing or able to absorb the costs—especially after a recession—and an uncertain economic outlook for the future.[299] Second, passing the costs on to the consumer rests on the assumption that the costs will not raise the purchase price so substantially that consumers decide not to buy the cars altogether.[300] Even if passing along the costs does not significantly raise the price of autonomous cars for consumers initially, the possibility that future

298. *See* Totty, *supra* note 290 (exploring the pros and cons of nuclear power).

299. *See* Carla Fried, *Fed: Consumer Spending Down $7,300 Per Person Since Great Recession Began*, CBS NEWS (July 12, 2011), http://www.cbsnews.com/8301-505123_162-41143140/fed-consumer-spending-down-7300-per-person-since-great-recession-began/ ("Kevin Lansing, an economist at the Federal Reserve Bank of San Francisco, took a look at how our current personal spending compares to what we would have spent if we had continued at the hectic, bubble-induced pace that ensued from 2000 until the Great Recession began in December 2007. According to Lansing, average per-person spending was $7,356 less (in inflation-adjusted dollars) than if our pre-recession spending spree had continued apace. That works out to $175 less per month that we've each been circulating back into the economy. Which goes a long way to explain why the economy isn't exactly humming these days.").

300. *See generally*, Julie Jargon & Ilan Brat, *Food Sellers Grit Teeth, Raise Prices*, WALL ST. J. (Nov. 4, 2010), *available at* http://online.wsj.com/article/SB10001424052748704506404575592313664715360.html ("For food executives, how quickly to pass along higher costs presents difficult choices. Missteps could be costly when the economy remains weak. Many Americans, nervous about high unemployment, have pledged allegiance to their pennies and are willing to trade down on brands, switch supermarkets, opt for Burger King over Applebee's, or stop dining out altogether to save money. 'The big challenge will be, how much can we swallow and how much can we pass along?' said Jack Brown, chief executive of Stater Bros. Markets, a 167-store grocery chain in southern California.").

costs may result still looms because the market and extraneous factors are not predicable.[301] Additionally, since the risk that autonomous cars pose is arguably high,[302] the automobile manufacturers are likely to be hesitant to take such high risks without mitigation. For example, General Motors' recent filing of Chapter Eleven in 2009 exemplifies that some of the largest and oldest corporations in the world are not infallible.[303]

With the help of a two-tier insurance framework and federal regulation, the investment of placing an autonomous car on the road will be worthwhile for manufacturers. The insurance framework will alleviate manufacturer's worries of uncertain, and possibly, substantial liability. Moreover, the framework will place no cost on consumers or the government. This proposal also upholds public policy concerns—that manufacturers should be responsible for the harms their products cause.[304] Furthermore, the program is proactive because it operates *ex ante* by establishing vehicle inspections in order to find problems with autonomous cars before they transpire. Additionally, the vehicle programs provide courts, consumers, and manufacturers with certainty as to who bears the liability after certain events occur.

301. *See id.* ("Ken Harris, a consumer foods-marketing consultant with Kantar Retail, said some food makers are targeting specific, low price points at retail—such as $1—and reconfiguring package sizes and products to fit the price. That can backfire when commodity costs rise swiftly. Early this year, Ben Tabatchnick, founder of Tabatchnick Fine Foods Inc., a maker of high-end frozen soups, decided to release a new line designed with a suggested retail price lower than his other products. The 11.5-ounce soups, which started appearing in stores nationwide in October, are smaller than his typical 15-ounce Tabatchnick-brand products and carry a price tag of $1.99. But in the last two months, Mr. Tabatchnick says his costs for vegetable oils, sugar, dried beans and other ingredients jumped 20% to 30%. 'It's going to reduce the [profit] margin dramatically on the product,' he says. 'We're stuck.'").

302. *See* Markoff, *supra* note 15 ("We think it's a scary concept for the public. If you have two tons of steel going down the highway at 60 miles an hour a few feet away from two tons of steel going in the exact opposite direction at 60 miles an hour, the public is fully aware of what happens when those two hunks of metal collide and they're inside one of those hunks of metal. They ought to be petrified of that concept.") (quoting O. Kevin Vincent, Chief Counsel of the National Highway Traffic Safety Administration).

303. Neil King, Jr. & Sharon Terlep, *GM Collapses Into Government's Arms*, WALL. ST. J., Jun. 2, 2009, at A1, *available at* http://online.wsj.com/article/SB124385428627671889.html ("General Motors Corp. became the second-largest industrial bankruptcy in history Monday as it filed its landmark case, with President Barack Obama predicting the humbled corporate titan will emerge from Chapter 11 "a stronger and more competitive" company within months.").

304. RESTATEMENT (SECOND) OF TORTS § 402A cmt. c (1965).

Lastly, the insurance framework furthers car manufacturers' chief concern—increasing profit margins—by placing a ceiling on damages and providing car manufacturers with insurance that will arguably provide the manufacturers with full coverage. Thus, like many other industries, products and strict liability still apply to autonomous cars, as the manufacturers should compensate those their products harm. Yet, due to the social utility of autonomous cars, manufacturers also deserve a special insurance framework to reduce risk.

V. CONCLUSION

With the passing of time, cars are becoming more autonomous and independent of humans.[305] Cars can park themselves with minimal human intervention,[306] prevent accidents, and drive themselves on marked roads with almost no human involvement.[307] Still, with this shift in control from humans to technology, there also comes a shift in liability.[308] While autonomous cars will eliminate many accidents currently caused by human error, many other accidents will undoubtedly arise due to technological malfunctions.[309] Consequently, in order to ensure that autonomous car technology enters the marketplace in a timely fashion, the liability of autonomous car and technology manufacturers requires mitigation.

The autonomous car industry should adopt a two-tiered insurance framework, similar to that of the nuclear power industry that would also establish a ceiling on damages.[310] A similar two-tiered insurance framework is necessary to provide certainty to manufacturers of autonomous cars and technology regarding their liability so they have an incentive to develop and produce autonomous cars. Hence, if the current liability framework is not altered in some way, autonomous cars will take much longer to enter the market and society will be unable to fully reap the benefits of autonomous cars until a much later time. With the current state of transportation and the burden it has on society,[311] it is desirable that autonomous cars enter the marketplace as soon as possible.

305. Vanderbilt, *supra* note 286 (displaying an interactive timeline of car's "Automatic Transition.").

306. Murray, *supra* note 33.

307. Hachman, *supra* note 43.

308. KALRA ET AL., *supra* note 217.

309. Koebler, *supra* note 226.

310. *See, e.g.*, 42 U.S.C. § 2210 (2006).

311. *See Life in the Slow Lane*, THE ECONOMIST (Apr. 28, 2011) *available at* http://www.economist.com/node/18620944 ("Americans are gloomy about their economy's ability to produce. Are they right to be? We look at two areas of concern, transport infrastructure and innovation.").